Titulació:

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Study, Microencapsulation of beta-carothens
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1. Background

Since the decade of the 30s the technology starts to improve with an incredible speed. This situation has inevitably derivate to the pharmacology or cosmetic field. Nowadays, there are a lot of new and better techniques for microencapsulation and, in the future, this will jump to the military industry and will derivate to the same situation of nuclear power. After the start of this project, there was two PhD students on the UPS working on this field and this help us (all the students) to achieve a better knowledge on this field.

2. Motivation

The first time Dr. Manel Jose Lis Arias present to me this project, I was surprised. Although the microencapsulation start a long time ago, day by day the Scientifics publish new articles and the methods and the techniques can change in less than a week. After an initial research, I realised this is a new "world" to get explored and I was lucky to get the chance to do it. I hope that, with all the work achieved with this project, Dr. Lis and I, we have placed the settlements for further investigations on this field and other researchers will be able to benefit of our conclusions and experience.

3. Objective

The objective of this project is to verify if, using the solvent evaporation technique, the coating materials of Polylactic acid, Poly(lactic-*co*-glycolic acid), Eudragit, Gel-Arab Gum reach the same conditions used on the industrial world. Another objective is to get the student the basic knowledge of the microencapsulation field.

4. Gratitude

First of all I want to give my gratitude to Dr. Manel Lis Arias for all his help during my studies on the UPC. Without his help and his in conditional support I could not arrive where I am now. Is one of the best professionals I never met and I want to wish him a great life. Besides I want to say thanks to all the teacher I met throughout my degree because I could learn all my current knowledge.

On my personal life, I could not arrive here without the support of my family and the education they give to me. At least, but not less important, say thanks to my friends for all the support since we met. Without them I never have been the human I am now.

5. INTRODUTION

5.1.Microencapsulation

The definition of microencapsulation is the application of a thin polymer coating to an individual molecule or group of molecules (a.k.a. active agent) for protect this from the environmental hazards and incress the efectivity during the application of the active molecule and to improve the control of the drug release. The capsules obtained have a range of size from 5-5000 µm. Microencapsulation is a modified form of film coating, differing only in the size of the particles to be coated and the method by which this is produced (Bandi et al. 2004).Tthis technique is used on the pharmacologic industry, drug industry and chemical industry for mention some of the sectors.

It is necessary to throwback to 1931 to find the first investigation of microencapsulation on pharmacology industry, that consisted on preparing gelatine spheres using coacervation technique. Since this point the process and the core materials have been improved to reach the current situation. to find the first time that a company could successful developed and commercialized microcapsules , was on 1951, when The National Cash Register (NCR) create carbonless copy paper. Since this point, microencapsulation technology has been constantly improve for variety of propose and uses.

Through history have been use a big range of core materials such as live cells, active enzymes, vitamins, fragrances and pharmaceuticals. The most used material as a coat material has been the organic polymers (because their characteristics) but their also use fats and waxes.

The microcapsules offer a great advantage in compeer of the old methods, the main advantages are explain below [1]: Patients to consume lower dose for reach the therapeutic effect; the risk of side effects decrees; masking of odor or taste for chewable tablets; powders and suspensions for children's medicines; prolong action dosage form; modify the physical characters of a material which is required in certain formulations; protect chemicals against degradative reactions such as oxidation, dehydration...; controlled and targeted drug delivery; diagnostic aids and medicals equipment design, liquids can be handled as solids, safe and convenient handling of toxic substances; and separation of incompatible components

5.1.1. Morphology and types of microcapsules

In general, there are two different way to classify the microcapsules: depend their size or depend their morphology (the distribution of the core material inside the microcapsule). For the first kind of classify them we can find it on the Figure 1:

Terminology	Description	Size range	Schematic illustration
Microcapsules (narrow sense of meaning)	Products of coating liquid nuclei with solid walls.	µm	
Nanocapsules	Same structure as microcapsules, but smaller.	nm	
Microspheres or microparticles	The cores and walls are both solid. Often, there is no clear distinction between them: the thick solid wall functions as a porous matrix where active substances are embedded.	µm	
Nanospheres or nanoparticles	Same structure as microspheres, but smaller.	nm	
Liposomes	Lipid wall, often made of phospholipids and cholesterol. Subtypes: unilamellar (one lipid layer) and multilamellar (several lipid layers).	µm to nm	
Niosomes	Similar to liposomes but their membranes are made of synthetic amphiphylic molecules (detergents).		

Figure 1: Terminology of microencapsulation products based on their size [2]

If we use their morphology for classify them, there are three groups: if the microcapsules have a spherical geometry with a continuous core region surrounded by a continuous shell, the group is called *mononuclear or continuous core/shell microcapsules*; if the microcapsules have a irregular geometry and contain a number of particles of core material, the group is called *multinuclear or polynuclear microcapsules*; if the core material is distributed homogeneously into the shell material (coating material), the group is called *matrix microcapsules*.

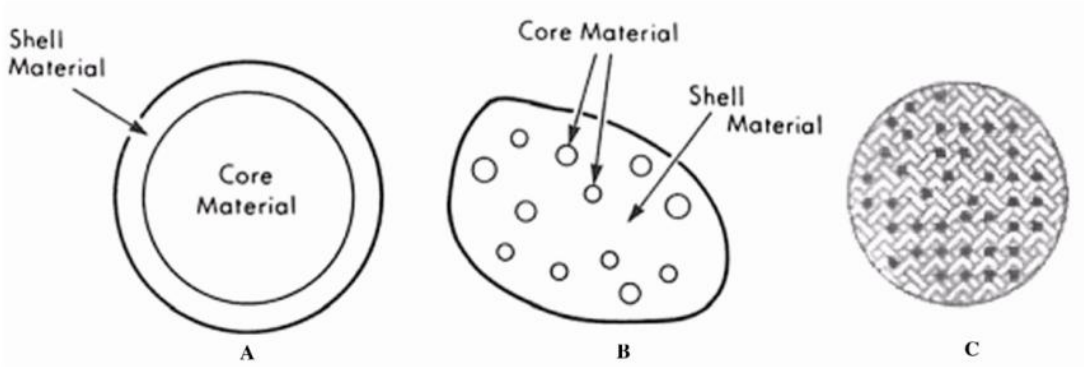


Figure 2: Morphology of microcapsules [1]: (A) Mononuclear microcapsule; (B) Multinuclear microcapsule; (C) Matrix microcapsule

5.1.2. Techniques for microencapsulation

Microencapsulation is a multidisciplinary field based on the knowledge and methods of colloid chemistry, polymer chemistry, physical chemistry, biochemistry, physics, biotechnology, and material sciences [1].

Microencapsulation techniques are mainly based on the emulsion of the coat material in a solution with the coating material and other reagents that improve the efficiency or the characteristics of the microcapsules. The way to classify the different types of emulsions is based on the composition and morphology of the dispersed and continuous phase. This classification can be separate in two groups: if the emulsion is composed by two phases or by more than two.

When the emulsion is composed only by two different phases, thereby it can be a water-in-oil emulsion (W/O) where water is the dispersed phase and oil is the continuous phase or oli-in-water emulsion (O/W) where oil is the dispersed phase and water is the continuous phase.

On the other group it appears to have a same situation, on one part if the W/O emulsion is dispersed into a water continuous phase it is called an W/O/W emulsion; but, if the O/W emulsion is dispersed into an oil continuous phase this is called O/W/O emulsion.

Another way to classify the microencapsulation process is the technique used for created them. There are two big groups depend if the method is chemical or if it is physical. Inside the second group it can be split in two other groups, physic-chemical and physic-mechanical (see Figure 3).

Chemical	Physical	
	Physico-chemical	Physico-mechanical
• Polymerization *In-situ* Emulsion, Suspension, Dispersion • Interfacial polycondensation	• Coacervation • Solvent evaporation, Solvent extraction • Layer-by-layer adsorption • Complex precipitation • Ionic gelation •Supercritical Fluid precipitation	• Spray-drying and congealing • Electrostatic encapsulation • Pan coating •Vacuum encapsulation • Extrusion • Air suspension • Multiorifice-centrifugal

Figure 3: Methods of microencapsulation [1]

As this project is focus on the pharmacological industry, the Figure 4 show the more relevant methodologies on this field.

Microencapsulation methods	Physical nature of the core material	Approximate particle size(μm)
Polymerization	solids and liquids	1-1000
Interfacial polycondensation	solids and liquids	3-2000
Coacervation	solids and liquids	2-5000*
Solvent evaporation	solids and liquids	5-5000*
Air suspension	solids	35-5000*
Pan coating	solids	600-5000*
Spray-drying and congealing	solids and liquids	600
Multiorifice centrifugal	solids and liquids	1-5000*

Figure 4: Microencapsulation methods and their explicabilities [1]

5.2.Antioxidants

Antioxidants are compound that inhibit oxidation (chemical reaction that can produce free radicals). On the plants and animals the antioxidants maintain a complex system to balance the oxidative stress; those can be produce internally or give by the dietary. For this reason, in the chemical industry they are added to product for prevent oxidation. It is extended use on food, cosmetics, pharmacology or in fuel. Moreover, the studies have not been shown any effect of them to the health in humans (based on mortality rate or cancer risk).

5.2.1. Health effects

Although certain levels of antioxidant in the diet are required for good health, it is unknown which antioxidants are health-promoting in diet. Even though dietary antioxidants have been investigated for potential effect on neurodegenerative disease, these studies do not have evidence of effects [4].

5.2.2. Drug candidates

Common pharmaceuticals with antioxidant properties may interfere with the efficacy of certain anticancer medication or radiation [5].

5.2.3. Adverse effects

Relative strong reducing acids can have ant nutrient effects by blinding to dietary minerals in the gastrointestinal tract and preventing them from being absorbed [6]. Some of the most common antioxidants are showed on the table 1:

Foods	Reducing acid present
Cocoa bean and chocolate, spinach and turnip	Oxalic acid
Whole grains, maize and legumes	Phytic acid
Tea, beans and cabbage	Tannis
Sweet potato, carrot, pumpkin	β-carotene

Table 1: Most commont antioxidants on food.

High doses of some antioxidants may have harmful long-term effects. As an example, some research show a relation between β-carotene and the in cress of the probability to have lung cancer [7]. The subsequent studies confirmed these adverse effects [8].

5.2.4. Examples of bioactivity

Antioxidants can be classified into two broad divisions, if they are soluble in water (hydrophilic) or if they are soluble in lipids (lipophilic). In general, water-soluble antioxidants react with oxidants in the cell cytosol and the blood plasma, while lipid-soluble antioxidants prtect cell membranes from lipid peroxidation [9].These componends may be synthesized in the body or obtained from the diet [10]. The relative importance and interaction between these different antioxidants is a very complex question, with having synergistic and interdependent effect on one another [11]

Antioxidant	Solubility	Concentration in human serum (μM)	Concentration in liver tissue (μmol/kg)
Ascorbuc acid (vitamin C)	Water	50–60	260 (human)
Glutathione	Water	4	6,400 (human)
Lipoic acid	Water	0.1–0.7	4–5 (rat)
Uric acid	Water	200–400	1,600 (human)
Carotenes	Lipid	β-carotene: 0.5–1	5 (human)
α-Tocopherol (vitamin E)	Lipid	10–40	50 (human)
Ubiquinol (coenzyme Q)	Lipid	5	200 (human)

Table 2: Common antioxidants

5.2.5. Uses in technology

5.2.5.1. Food preservatives

Antioxidants are used as food additives to help guard against food deterioration. Food is preserved by keeping in the dark and sealing it in containers or even coating it in wax. However, as oxygen is also important for plant respiration, packaging of fresh fruits and vegetables contains an 8% oxygen atmosphere.

5.2.5.2. Industrial uses

A common use is as stabilizers in fuels and lubricants to prevent oxidation, and in gasoline to prevent the polymerization. In 2014, the worldwide market for natural and synthetic antioxidants was US$ 2.25 billion with a forecast of growth to US$ 3.25 billion by 2020.

5.2.6. B-Carotene

Is an organic, strongly colored red-orange pigment abundant in plants and fruits of the carotenes family. His chemical structure is $C_{40}H_{56}$ (see Figure 5) and with a molar mass of 536.888 g/mol. Among the carotenes, is distinguished by having beta-rings at both ends of the molecular. In addition is biosynthesized from geranylgeranyl pyrophosphate [12]. β-carotene is the most common form of carotene in plants and, in nature, is a precursor to vitamin A via the action of beta-carotene 15,15'-monooxygenase [12].

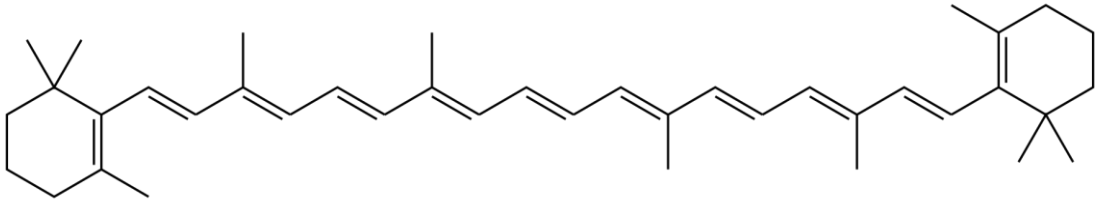


Figure 5: Chemical structure of β-carotene

5.3.Drug delivery

For several years one of the big goals on the pharmacological industry is to control the drug realise of their active components to improve the affectivity of the medicaments. Around the decade of 30s, their start to created mathematical models to be able to control this release.

Over the time have been several scientific whom create different mathematical models for the drug realise. Therefore on this project it is necessary to study and explain few of their mathematical equations: Higuhi equation [13], N.A. Pappas equations [14] and power law [14].

5.3.1. Higuhi equation

Until 1961 there have been many equations for modelling the drug realises but no one was extended used. This year Higughi present his equations and since this point this equation became the most famous and often use for describer the release rate of drugs from matrix systems. Initially this equation was valid only for planar systems but, over the time, it have been modified and extended to consider different geometries and matrix characteristics. The basic Higuhi equation is:

$$\frac{M_t}{A} = \sqrt{D(2c_o - c_s)c_s t} \qquad for\ c_o > c_s$$

(1)

Where:

M_t= Comulative absolute amount of drug released at time

A= Surface area of the controlled release device

D= Drug diffusivity

c_o= Initial drug concentration

c_s= Solubility of the drug in the polymer

t= time

This equation can be summarized and expressed as:

$$\frac{M_t}{M_{inf}} = K_H\sqrt{t}$$

(2)

Where:

M_{inf}= Absolute cumulative amount of drug released at infinite time

K= Constant reflecting the design variables of the system.

However, when Higuhi's derivation equation is use, there are some situations that should be kept in mind [14]:

Initial drug concentration in the system is higher than the solubility of the drug. This is very important because it provide the base for justify the applied the derivation equation (see *Figure 1*).

The mathematical analysis is based on one-dimensional diffusion. So, edge effects must be negligible.

The suspended drug's diameter is much smaller that the thickness of the system.

Swelling or dissolution of the polymer carrier is negligible.

The diffusivity of the drug is constant.

Perfect sink conditions are maintained

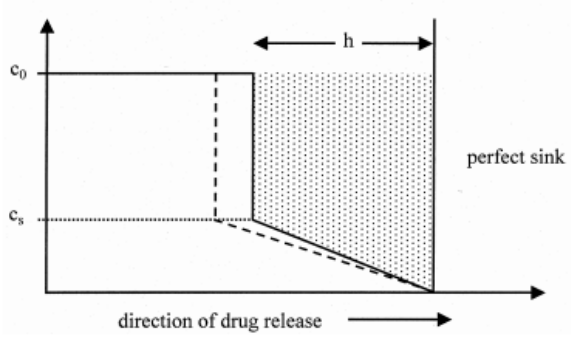


Figure 6: Pseudo-study state approach [14]

5.3.2. Models to describe drug release depend the geometry

On 1986, Nikolaos A. Peppas create a mathematical model of drug release based on the three most common geometries used on drug-delivery systems (thin film, cylindrical sample and spherical sample). This mathematical models are based on Fick's law, whose studies are used as base for to almost all the mathematical models since their publishing.

Release from thin polymer film

Consider one-dimension thin polymer slab of *l* thickness, where the system is initially maintained at a constant uniform drug concentration (C_1) and on the surface are kept on a constant drug concentration(C_0) became a *perfect sink condition*. From this situation the Fick's second law, considering a constant drug diffusion coefficient and one-dimensional diffusion on *x* direction, may be written as:

$$\frac{\partial C}{\partial \tau} = D\frac{\partial^2 C}{\partial x^2}$$

(4)

Where

$$\begin{aligned} &\tau = 0 \quad && -l/2 < x < l/2 \quad && C = C_1 \\ &\tau > 0 \quad && x \pm l/2 && C = C_0 \end{aligned}$$

From this equation, on a trigonometric situation, become on:

$$\frac{M_t}{M_{inf}} = 1 - \sum_{n=0}^{\infty} \frac{8}{(2n+1)^2\pi^2} exp\left[\frac{-D(2n+1)^2\pi^2}{l^2}\tau\right]$$

(5)

A useful interpretation of the equation (4) for short-time behaviour (60% of the release drug) can be approximated by [14]:

$$\frac{M_t}{M_{inf}} = 4\left[\frac{D\tau}{\pi l^2}\right]^{1/2}$$

(6)

Release from cylinder

For one-dimensional radial cylinder of radius α, under perfect sink with a constant drug diffusion coefficient D, Fick's second law can be written as [14]:

$$\frac{\partial C}{\partial \tau} = D\left[\frac{\partial^2 C}{\partial r^2} + \frac{1}{r}\frac{\partial C}{\partial r}\right]$$

(7)

Where

$$\tau = 0 \quad 0 < r < \alpha \qquad C = C_1$$
$$\tau = 0 \quad r = \alpha \qquad C = C_0$$

The solution to Fick's law under above-specified conditions is:

$$\frac{M_t}{M_{inf}} = 1 - \sum_{n=0}^{\infty} \frac{4}{\alpha^2 \alpha_n^2} exp[-D\alpha_n^2 \tau]$$

(8)

A useful interpretation of the equation (4) for short-time behaviour (10-15% of the release drug) can be approximated by:

$$\frac{M_t}{M_{inf}} = 4\left[\frac{D\tau}{\pi\alpha^2}\right]^{1/2} - \pi\left[\frac{D\tau}{\pi\alpha^2}\right] - \frac{\pi}{3}\left[\frac{D\tau}{\pi\alpha^2}\right]^{3/2} + \cdots$$

(9)

Release for spheres

For one-dimensional from a sphere of radius α, under perfect sink with a constant drug diffusion coefficient D, Fick's second law can be written as [14]:

$$\frac{\partial C}{\partial \tau} = D\left[\frac{\partial^2 C}{\partial r^2} + \frac{21}{r}\frac{\partial C}{\partial r}\right]$$

(10)

Where

$$\tau = 0 \quad 0 < r < \alpha \qquad C = C_1$$
$$\tau > 0 \quad r = \alpha \qquad C = C_0$$

The solution to Fick's law under above-specified conditions is:

$$\frac{M_t}{M_{inf}} = 1 - \frac{6}{\pi^2}\sum_{n=0}^{\infty}\frac{1}{n^2}exp\left[\frac{-Dn^2\pi^2\tau}{\alpha^2}\right]$$

(11)

A useful interpretation of the equation (4) for short-time behaviour (10-15% of the release drug) can be approximated by:

$$\frac{M_t}{M_{inf}} = 6\left[\frac{D\tau}{\pi\alpha^2}\right]^{1/2} - 3\frac{D\tau}{\alpha^2}$$

(12)

5.3.3. Power law

It can be extract a semi-empirical equation to describe drug release from polymeric systems called power law. This power law depends on Fickian's diffusion equations; therefore, it can be only applied on the 60% of the total release (on some cases only the 10-15%). The general equation is [13]:

$$\frac{M_t}{M_{inf}} = Kt^n$$

(13)

Where:

M_t= Absolute cumulative amount of drug released at time

M_{inf}= Absolute cumulative amount of drug released at infinite time

K= Constant incorporating structural and geometric characteristics of the device.

n= Release exponent, indicative of the mechanism of drug release

There are three different situations depending on the *n* values (this values must be given by an experimental test) and the range of values of *n* is show on the Figure 7.

Diffusional exponent, n			Drug release mechanism
Thin film	Cylindrical sample	Spherical sample	
0.50	0.45	0.43	Fickian diffusion
$0.50 < n < 1.00$	$0.45 < n < 1.00$	$0.43 < n < 1.00$	Anomalous (non-Fickian) transport
1.0	1.0	1.0	Zero-order release

Figure 7: exponent n of the power law and drug release mechanism from polymeric controlled delivery systems of different geometry

Fickian diffusion: The drug realise depend of the time and the geometry and it can be controlled.

Anomalous transport: Indicate the superposition of *Fickian diffusion* and *Zero-order release*. This situation is only valid for slab geometry.

Zero-order release: The drug release is independent of time and geometry and it can not be controlled.

5.4.Absorbance

5.4.1. Basic concepts

The electromagnetic radiation (known for almost all the population as light) can be described as a wave with four properties: wavelength, frequency, velocity and amplitude. However, when we speak about absorption, we can not take into account only the previous properties and we have to consider the electromagnetic radiation as an energy packages (known as photons). In summary, we should consider the electromagnetic radiation as a wave and particle

Wave properties

For the study of reflexion, refraction and diffraction the electromagnetic radiation can be present as a sine wave with magnetically and electrical fields (blue and red respectively and the wave direction on black)

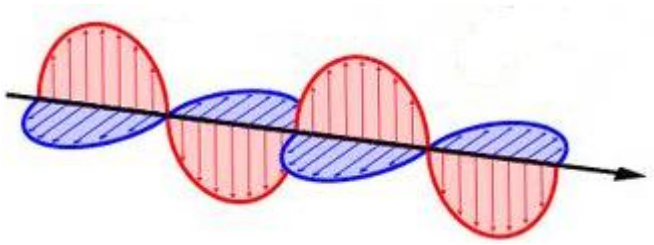


Figure 8: Magnetically & electrical fields [1]

In our study case, we get into the electrical field. On the figure 2 we can find a 2D representation of an electrical field. The x axis show the time of the radiation passing through one point.

Wave characteristics

The amplitude (A) of the electromagnetically wave is the vector quantity used for measure the force of the magnetically or electrical field on his maximum point on the studied wave, expressed on cd.

The period (p) of the radiation is the time passed between successive maximum or minimum points (from a wave) through one fixed point, is expressed on seconds (s).

The frequency (v) is the number of oscillations of the electrically field vector per time unit, expressed on s^{-1}, and it is the reverse of the period (1/p). The frequency of any electromagnetically wave is determined by the original source and it is constant regardless the surface or medium that goes through

$$v = \nu * \lambda \quad (14)$$

it shows the relation between the frequency and the velocity (v) and wavelength (λ). The velocity, expressed on cm s^{-1} or m s^{-1}, unlike the frequency is affected by the source and depends on the frequency. The wavelength is the lineal distance between successive maximums or minimums of the studied wave. The units used for express the wavelength is showed on Table 1 because depend of the spectrum regions.

Region	Unit	SI equivalence
X rays	Ångström (Å)	10^{-10} m
UV/Vis	Nanometers (nm)	10^{-9} m
Infrared	Micrometers (µm)	10^{-6} m

Table 3: Wavelength's units for some spectrum regions

Power and intensity of radiation

The power of radiation (P) is the energy of a beam that reaches one area per unit of time, expressed on watts (W), and the intensity of radiation is the power of radiation per solid angel unit. Both are proportional to the square of the electrically field amplitude.

5.4.2. Radiation absorption

The absorption process transfer energy to the molecule and decrees the intensity of the incident electromagnetically radiation. When this happens the absorption of the radiation from the molecules attenuates the beam. This is because each molecular species can absorb his own characteristic frequency of electromagnetically radiation. This situation is explained on the Beer-Lambert law.

Absorption process

The **Beer-Lambert law** (known as **Beer law**) show the way that the attenuation grade depends on the concentration of the absorbent molecules and the length where the absorption process happens. *In spectroscopy, the meaning of attenuation is decrees the energy per area of one beam of radiation* [3]. As we explain before, when the beam of radiation pass through a sample (this sample have to be on a liquid medium) this absorb their specific radiation energy causing the attenuation of the beam of radiation. This attenuation can increase or decrees because of two factors: on a constant medium (related to the longer of the medium) if we have more concentration we will have more attenuation; as longer is the medium, the beam of radiation find more molecular or atoms on his way and their (the atoms) absorb more radiation.

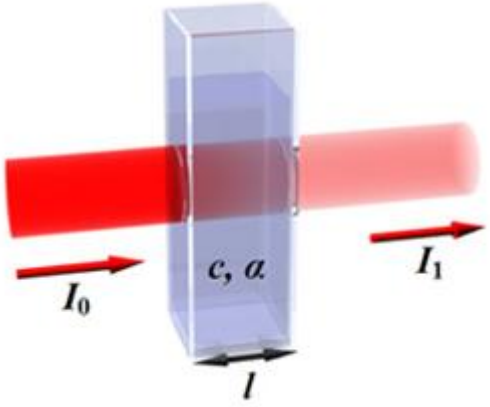


Figure 9: Attenuation effect [16]

The figure 2 represents one beam of monochromatic radiation passing through bucket (inside with we find our sample) with one specific thickness (*l*, cm) and one concentration (c, mol/l). As we explain before, the attenuation is given by the energy absorption from the sample's atoms. In consequence, the radiant energy decrees while is passing through the bucket from I_o to I_1. The equation 2 show the fraction of radiation that passes through a solution, at a specific wavelength, is called transmittance (T) and it is use to express as a percentage (equation 16)

$$T = \frac{I_1}{I_o}$$

(15)

$$\%T = \frac{I_1}{I_o} * 100$$

(16)

Absorbance

The absorbance (A) is the common logarithm of the transmittance and it shows the quantity of absorb light for the studied analyte. This relation is express on the equation 17

$$A = -\log T = \log \frac{I_o}{I}$$

(17)

Beer law

According to Beer law, the absorbance is directly proportional to the absorbent's specie concentration (c, g/L) and the thickness of the studied solution (b, cm):

$$A = abc$$

(18)

Where a is the **attenuation coefficient** (or extinction coefficient or absorptivity) and their units are determinate from the b and$c$. Using our case as an example, the a units are L/(g cm). If we relate the concentration in molar units (mol/L), the absorptivity is known as **molar attenuation coefficient** (or molar absorptivity) and the units are L/(mol cm):

$$A = \varepsilon bc$$

(19)

Application of Beer law

On the previous section we explain some interference that can affect the lecture of the absorbance. Because of this we can not use the equation 6 for know the concentration of our sample with only the absorbance. We have to created a calibration curve (or work curve) using patron solutions with the same dissolvent and known concentrations. From the calibration curve we obtain one linear regression and the following equation

$$y = mx \pm b$$

(20)

Where y is the absorbance, x is the anality concentration, b is the ordered in origin of y (only when x is zero) and m is the slope. The slope comes from:

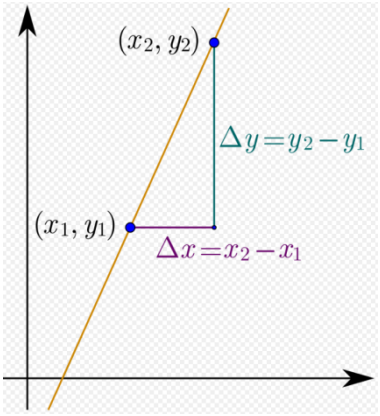


Figure 10: Slope

$$m = \frac{\Delta y}{\Delta x} = \frac{y_2 - y_1}{x_2 - x_1}$$

(21)

Molecular absorption

There are three kinds of photonic transitions when the molecules are excited by ultraviolet, visible or infrared radiation: electronic transition, vibratory transition and rotational transition. The two last transition type only happens with polyatomic species because it is necessary a central atom that acts like an anchor.

The **electronic transition** is caused by the two first radiation type, those exited the molecular (or atom) and cause the promotion of one electron from one low energy orbital to one high energy orbital. This situation happens when the photon's energy (hv) is exactly the same energy need for this electron to move from one to the other orbital.

The **vibratory transition** is the action of the atom's movements anchored in one central atom. The figure 6 shows different types of molecular vibration, on the first row for each vibration both atoms get close and away from the central atom (symmetric stretch vibration) or their actions are opposite (asymmetric stretch vibration); on the second and third row we fine four examples of flexion vibration, the left column represent both atoms acting on the same way but the right column their act on the opposite way.

The **rotational transition** is the action of the molecular around his own gravitational centre. As an example, we can imagine our molecular like the earth (or any other planet). The earth rotates on its own axis and the same happens with our molecular.

Each transition type has his own energy and the sum of the three give the molecular energy:

$$E = E_{enectronic} + E_{vibratory} + E_{rotational} \quad (22)$$

6. Research approach

6.1.Materials used for manufacturing the microcapsules

The materials (reagents) used on this project are explained below.

6.1.1. Biocompatible polymers and active agents

As it is explained on the *objective* section, the final use of the microcapsules is to protect the human skin. Thereby the coating materials used is biocompatible polymers and they were used five:

Polylactic acid (PLA) (used DCM as a solvent)

Poly(lactic-*co*-glycolic acid) (PLGA) (used DCM as a solvent)

Eudragit (used acetone as a solvent)

Gel-Arab Gum (used water as a solvent)

Chitosan (used DCM as a solvent)

The active component used is in all the microencapsulated process is the β-carotene (99% of purity) and it was dissolved with 1-propanol because the β-carotene is soluble in water.

6.1.2. Surfactants and cross-link agent

There were used many different surfactants on this project. On the first block, it was use Paraffin wax, Poly vinyl alcohol (PVA), Styrene maleic anhydride (SMA). For the second block, on the first approach it was used the PVA and, on the second approach it was used Tween 20. All the surfactants were dissolved using water minus for the paraffine wax because his state is liquid.

The cross-link agent used on the second approach was tannic acid and it was dissolved using water.

6.1.3. Textile substrates

The textile substrates used were: Cotton (CO) (Style 400, ISO 105 - F02) and Polyester (PES) (Style 777, ISO 105-F04)

6.2.Experimental methods and techniques

The methods and techniques used on this project are explained below following the same structure according their timing of used.

6.2.1. Making the microencapsulation

As it is explained on *section 1*, there are two blocks of process: one block where it was change the coating material; other block were it was studied and improved the system using the same coating material. The emulsions used are $O/W_1/W_2$ for the approach using different coating materials and, on the approach using chitosan as a coating materials, the first emulsion made was O/W and the second was $O/W_1/W_2$ using conventional solvent evaporation method [2].

Block 1: Different coating material

On the block 1, there are different reagents used on each approach but the mechanical part (during the stirring) is almost the same. The active component (β-carotene) was solved using acetone (when the coating material was Gel-Arabic gum or eugardit) or DCM (PLA and PLGA). As a coating materials were used 4 different materials: Eugardit (solved with acetone), PLA (solved with DCM), PLGA (solved using DCM) and Gel-Arabic gum (solved using distillate water). In the case of the surfactant, it was used distillate water in almost every case (less with the process of GA).

The mixture of the core's solution and the coating's solution were generated by mechanical agitation (Ultra-Turrax T25, Figura 11, Table 4) for several minutes. Besides, with the GA process, the mix should be at 50ºC using a thermostated water bath (Frigiterm 6000382, Figure 12). The surfactant solutions were mixed by mechanical agitation (Ultra-Turrax T25, Figura 11, Table 4) for several minutes. Afterwards, to making the emulsions were mix by mechanical agitation (blade starring, Figure 14, Table 6). At last, the mixture was maintained under constant agitation until the evaporation of the solvent and the consequent formation of microcapsules (around 4h). Furthermore, on the GA process, for heat the reactor it was use a thermostated water bath (*Frigiterm 6000382*, Figure 12).

Block 2: Same coating material

Briefly, on the first approach the active component (β-carotene) and the polymer (chitosan) were separately solved using 1-propanol and DCM respectively; the surfactant used is PVA and was solved using water. On the other hand, for the second approach the active component and the polymer were done with the same method; however, the surfactant used (Tween 20) and the cross-link agent (Tannic acid) were separately solved using water as a solvent for both.

The mixture of the core's solution and the coating's solution were generated by mechanical agitation (Ultra-Turrax T25, Figura 11, Table 4) for several minutes at 4ºC using a thermostated water bath (Frigiterm 6000382, Figure 12). The surfactant solutions and the cross-link agent were mixed by mechanical agitation (Magnetic starring, Figure 13, Table 5) for several minutes. Afterwards, to making the emulsion O/W or O/W_1/W_2 were mix by mechanical agitation (blade starring, Figure 14, Table 6). At last, the mixture was maintained under constant agitation until the evaporation of the solvent and the consequent formation of microcapsules (around 24h).

Figure 11: Ultra-turrax T25

Manufacturer	**IKA**
Model	T25
Power	500 W
Speed range	3500-24000 rpm
Sample volume	1-2000ml

Table 4: Specifications of Ultra-turrax T25

Figure 12: Frigiterm 6000382

Figure 13: Magentic starring with heating

Manufacturer	**J.R. Selecta**
Model	7000343
Power	630 W
Speed range	60-1600 rpm
Sample volume	1-10000ml

Table 5: Specifications of magnetic starring

Figure 14: Blade stirring

Manufacturer	**Heidolph**
Model	RZA2020
Power	500 W
Speed range	500-15000 rpm
Sample volume	1-2000 ml

Table 6: Specifications of Heidolph RZA 2020

6.3.Characterisation of microspheres

There were done three tests for characterize the microspheres obtained: encapsulations efficiency, particle size and drug realise.

6.3.1. Encapsulation efficiency

The yield was detected indirectly in the liquid phase by UV/VIS Spectrophotometer (Shimadzu UV-2401 PC; Figure 15, Table 7) after centrifugation (Figure 16) for several minutes until the β-carotene has opted out. The equation use for define the yield is show under these lines:

$$yield = \frac{C_0 - C}{C_0} * 100$$

(23)

Were:

C_0= Initial concentration of β-carotene.

C= Concentration of β-carotene after manufacturing the microcapsules.

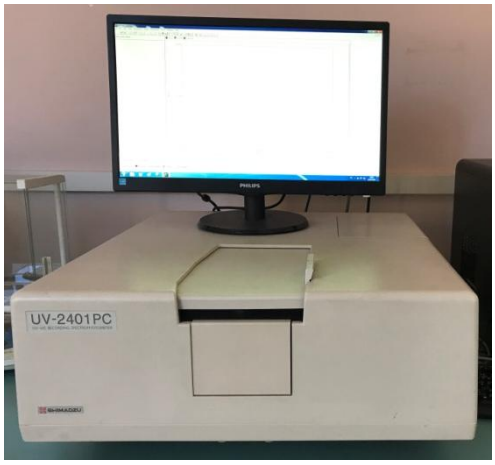


Figure 15: UV/Vis Spectrophotometer

Manufacturer	**Shimadzu**
Model	190 to 900 nm
Power	Single monochromator with a high-performance blazed holographic grating in the aberration corrected Czemy-Tumer mounting
Speed range	0.1 nm
Sample volume	50 W halogen lamp (2,000 hours life) and D2 lamp (500 hours life) Personal Spectroscopy Software (standard) Spectrum, Quantitative, Time Course

Table 7: Specifications of UV/Vis Spectrophotometer

Figure 16: Centrifuge

6.3.2. Particle size

For discover the average size of the microcapsules first extracted 1 ml from the liquid phase and drop few drops to a slide and let it dry on the room. Afterwards, using an optical microscope (Figure 18) check the amount of microcapsules and their size.

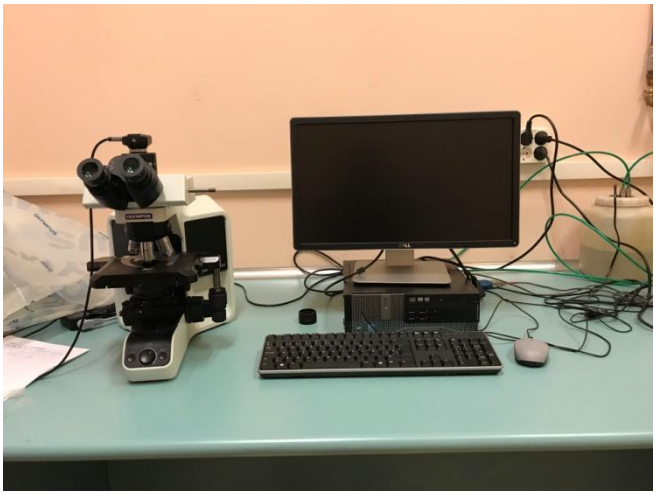


Figure 17: Optical microscope Olympus BX43

6.3.3. Drug release

The analyze of the drug on a controlled environmental was used a sample of 0.5 g of tissue, previously impregnated with microcapsules solution, inside an Erlenmeyer, at an specific bathe ratio with physiologic serum, and this submerged into a bath at a temperature of 37ºC (Figure 18). The purpose of this is control the hazard effects of the environmental (water or saline serum) on the drug release system, simulating the skin's sweat.

Figure 18: Memmert thermostated water bath

7. Experimental part

7.1.Calibration curve

Before start with the microencapsulation process, it is necessary to find the way to measure the amount of β-carotene microencapsulated (yield) or the results of the drug delivery. For that, the calibration curve provides the equation of the relation between the absorbance and the concentration (check *Application of Beer law*). Therefore, is necessary to obtained two calibration curve: one for β-carotene without Tween 20 and the other with it (this is because the Tween 20 can affect the absorbance of the solution)

7.1.1. Laboratory process without

Without Tween 20

For this part we will made a calibration curve of 20 points with low concentration because theoretically it will remain a little amount of β-carotene after the microencapsulation of them. The following table show the solutions use for made the calibration curve:

Concentration (mg/ml)								
0.002	0.004	0.006	0.008	0.01	0.012	0.014	0.016	0.018
0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09	0.1

Table 8: Table of concentrations for calibration curve

When we have the two mother solutions we can start with the preparation of the calibration curve's solutions. On the following table we show the amount of millilitres for each solution on a 25 ml volumetric flask:

Concentration (mg/ml)	**0.1**	**0.09**	**0.08**	**0.07**	**0.06**	**0.04**	**0.03**
Volume (ml)	5	4.5	4	3.5	3	2	1.5

Table 9: Table of millilitres from mother solution 0.5 mg/ml

Concentration (mg/ml)	**0.02**	**0.018**	**0.016**	**0.014**	**0.012**
Volume (ml)	10	9	8	7	6
Concentration (mg/ml)	**0.01**	**0.008**	**0.006**	**0.004**	**0.002**
Volume (ml)	5	4	3	2	1

Table 10: Table of millilitres from mother solution 0.05 mg/ml

When we have all the solutions ready, using the absorption spectroscopy we read the absorbance and we made the calibration curve.

With Tween 20

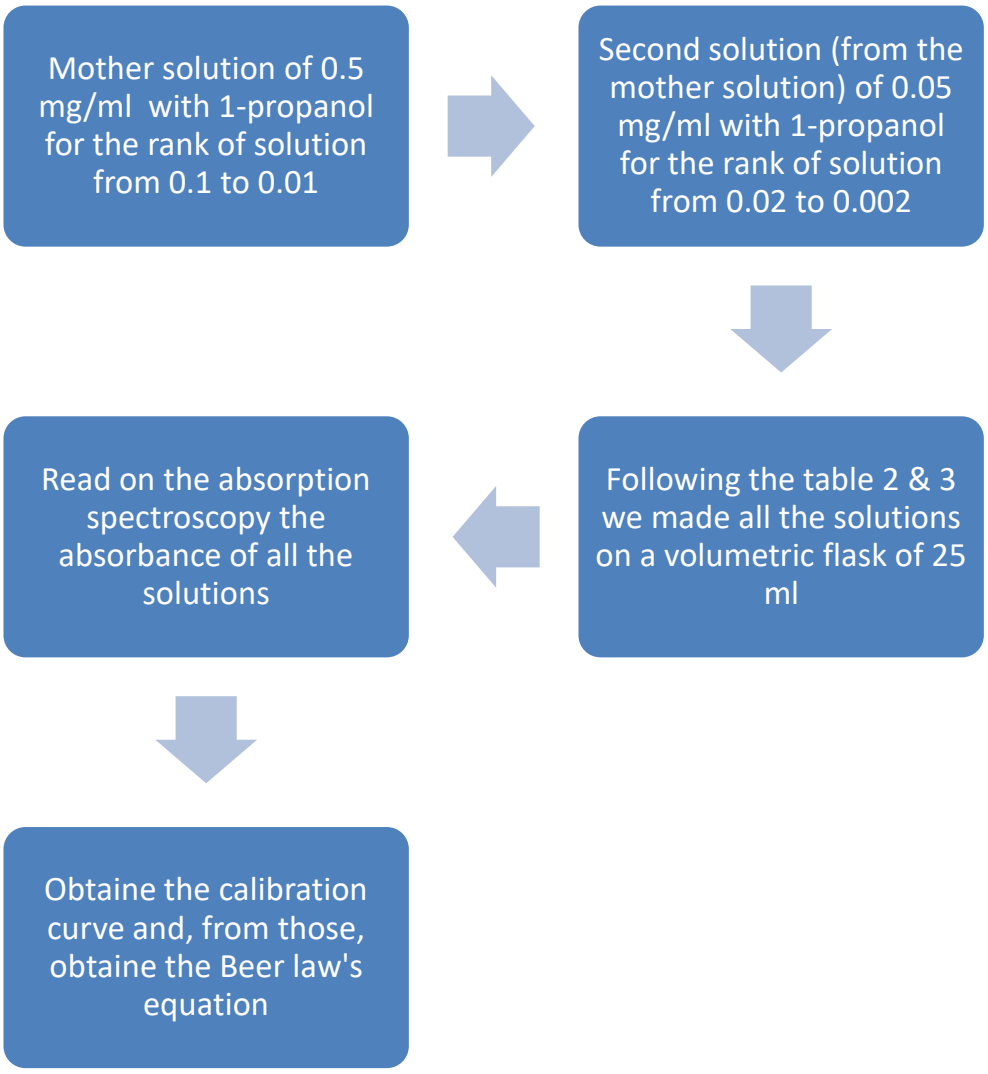
We want a constant molar ratio between β-carotene and Tween 20, for this reason we made a mother solution of β-carotene with Tween 20. As we know for our previous experience, this time we only do 10 points for the calibration curve:

Concentration (mg/ml)				
0.002	0.004	0.006	0.008	0.01
0.012	0.014	0.016	0.018	0.02

Table 11: Table of concentrations for calibration curve

7.1.2. Bloc diagram

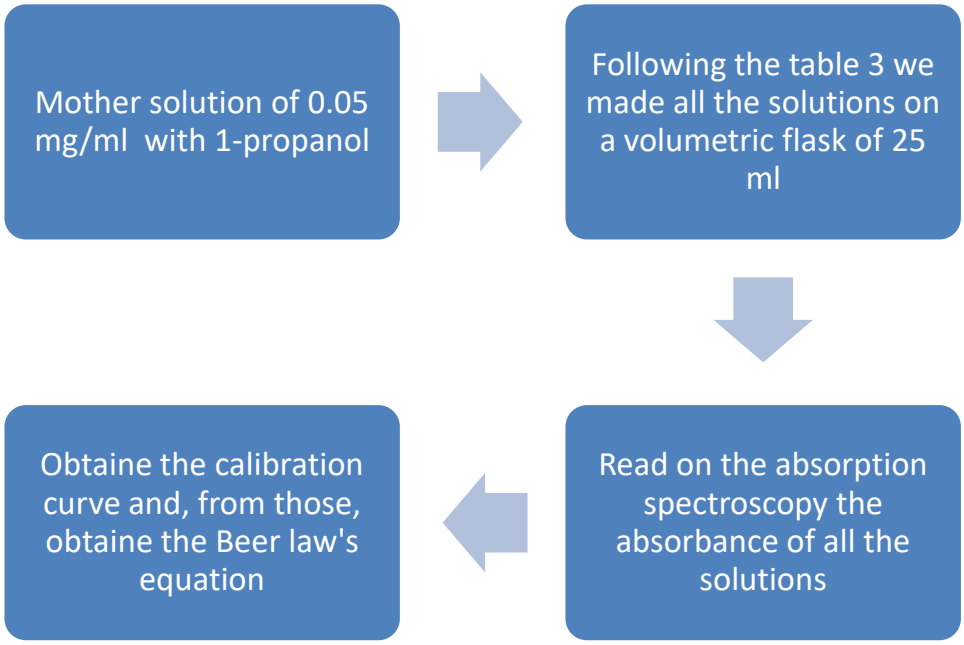
Without Tween 20



It is high recommend getting ready, at less, the half of the solutions before start with the absorbance readings and starting the measure from the lowest concentration to the highest concentration.

Figure 19: Different solutions of β-carotene

With Tween 20



7.1.3. Results

Without Tween 20

We show the results of the absorbance measure on the following table:

Concentration (mg/ml)	Molarity (mol/l)	ABS	
		481	454
0.002	3.73E-06	0.163	0.188
0.004	7.45E-06	0.326	0.375
0.006	1.12E-05	0.496	0.572
0.008	1.49E-05	0.654	0.754
0.01	1.86E-05	0.811	0.934
0.012	2.24E-05	0.965	1.114
0.014	2.61E-05	1.053	1.215
0.016	2.98E-05	1.139	1.314
0.018	3.35E-05	1.21	1.399
0.02	3.73E-05	1.748	2.065
0.03	5.59E-05	1.901	2.275
0.04	7.45E-05	1.996	2.343
0.05	9.31E-05	1.497	1.743
0.06	1.12E-04	1.57	1.827
0.07	1.30E-04	1.663	1.938
0.08	1.49E-04	2.344	2.787
0.09	1.68E-04	1.881	2.202
0.1	1.86E-04	2.63	3.029

Table 12: Results of absorbance measurements

With the results we can obtain the calibration curve and the Beer law's equation. First we get a graphic with all the results for study their behaviour and after we can obtain the equation

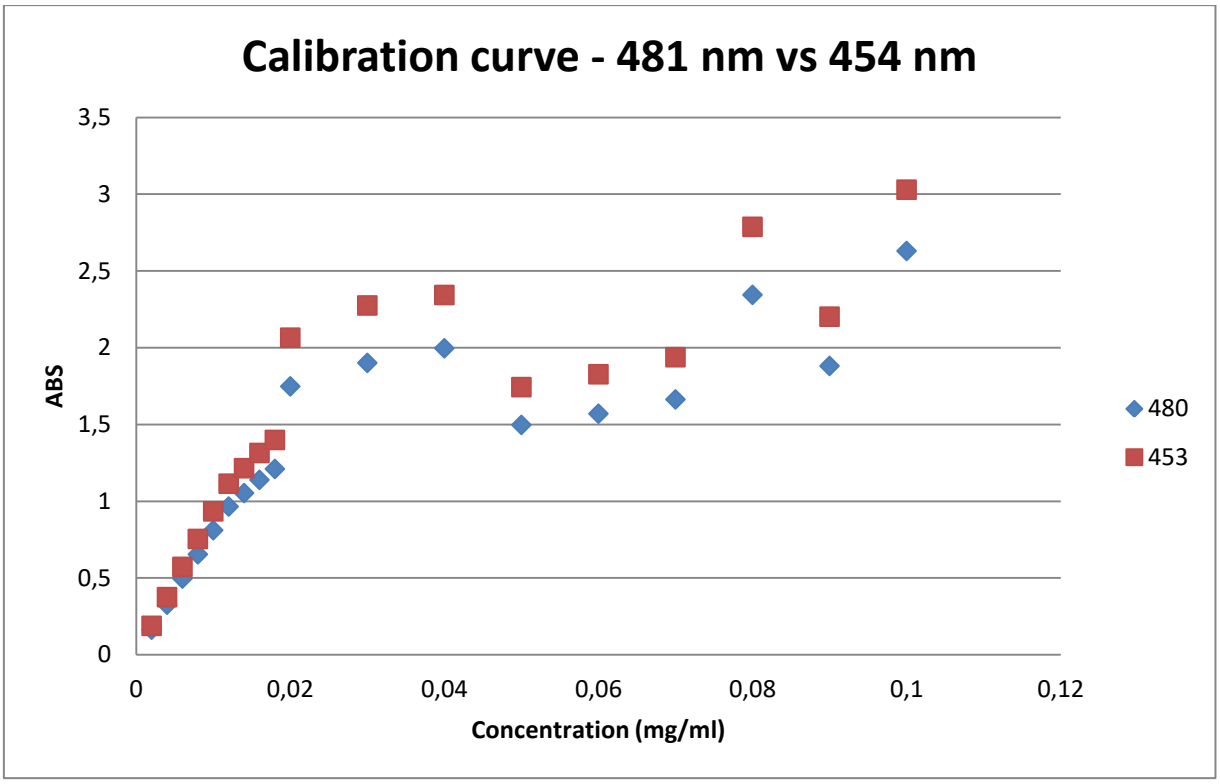


Figure 20: Calibration curve of both frequencies

As we can see, we find two different behaviours: form the rank 0.002 to 0.012 we see a lineal behaviour and from the rank 0.014 to 0.1 we see a non lineal behaviour. The situation of the second rank it is because the application of Beer law, the kinetic of the aggregation created this distortion on our measurements. Therefore we use the results of the first rank.

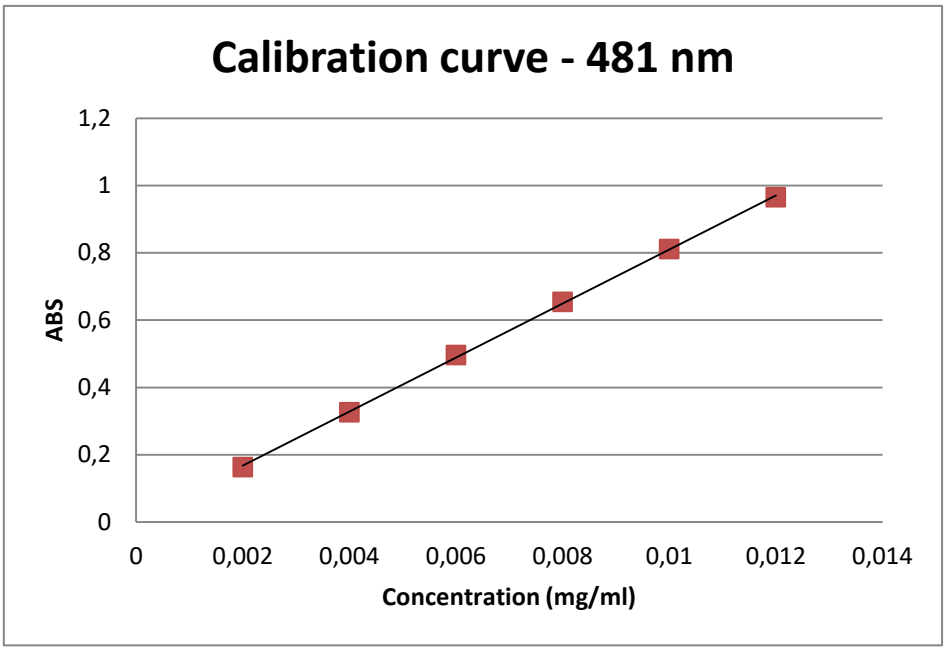


Figure 21: Calibration curve of 481 nm

$$y = 80.329x + 0.0069$$
$$R^2 = 0.997$$

(24)

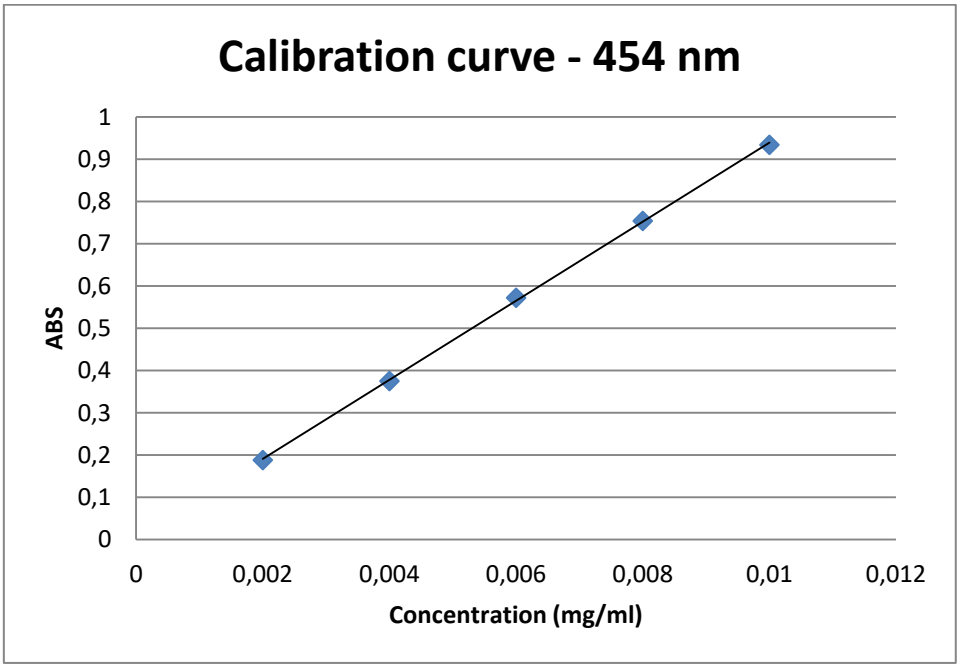


Figure 22: Calibration curve of 454 nm

$$y = 93.55x + 0.0033$$
$$R^2 = 0.997$$

(24)

With Tween 20

We show the results of the absorbance measure on the following table:

Concentration (mg/ml)	Molarity (mol/l)	ABS	
		279	220
0.002	3.73E-06	0.026	0.078
0.004	7.45E-06	0.078	0.151
0.006	1.12E-05	0.152	0.272
0.008	1.49E-05	0.204	0.316
0.01	1.86E-05	0.236	0.367
0.012	2.24E-05	0.247	0.38
0.014	2.61E-05	0.37	0.569
0.016	2.98E-05	0.395	0.61
0.018	3.35E-05	0.313	0.509
0.02	3.73E-05	0.22	0.48

Table 13: Results of absorbance measurements

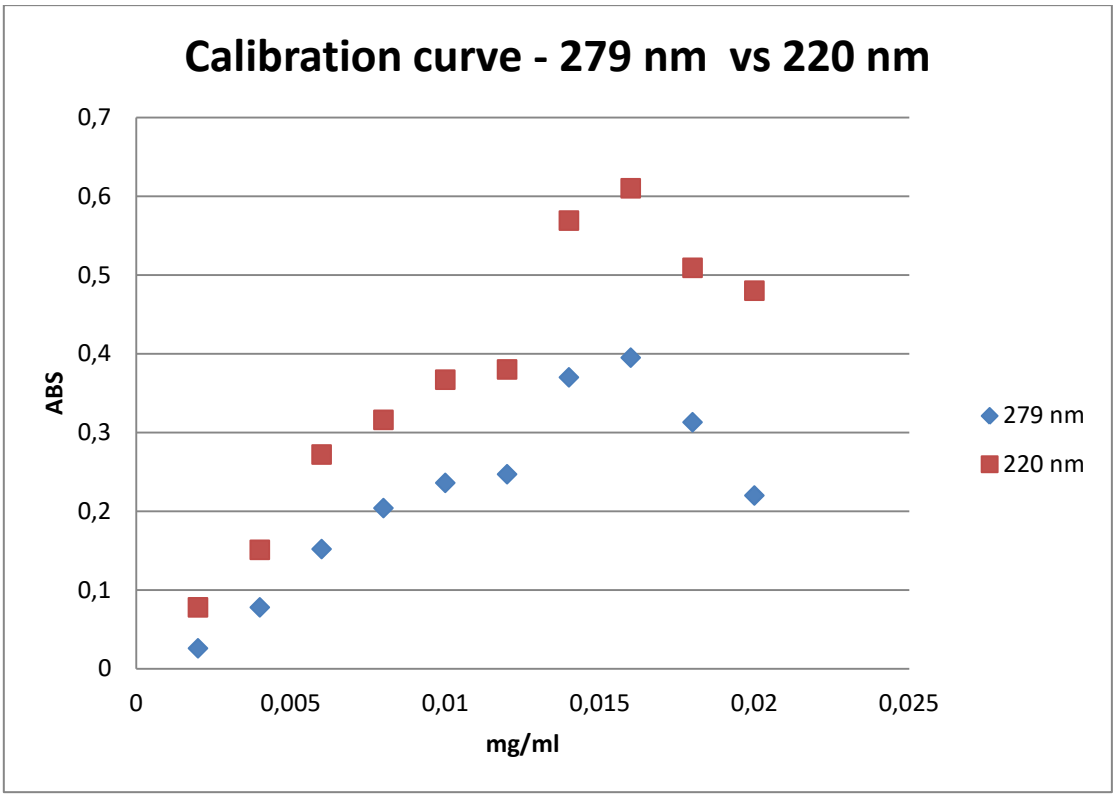


Figure 23: Calibration curve of both frequencies

As we can see, we find two different behaviours: form the rank 0.002 to 0.01 we see a lineal behaviour and from the rank 0.012 to 0.02 we see a non lineal behaviour. The situation of the second rank it is because the application of Beer law, the kinetic of the aggregation created this distortion on our measurements. Therefore we use the results of the first rank.

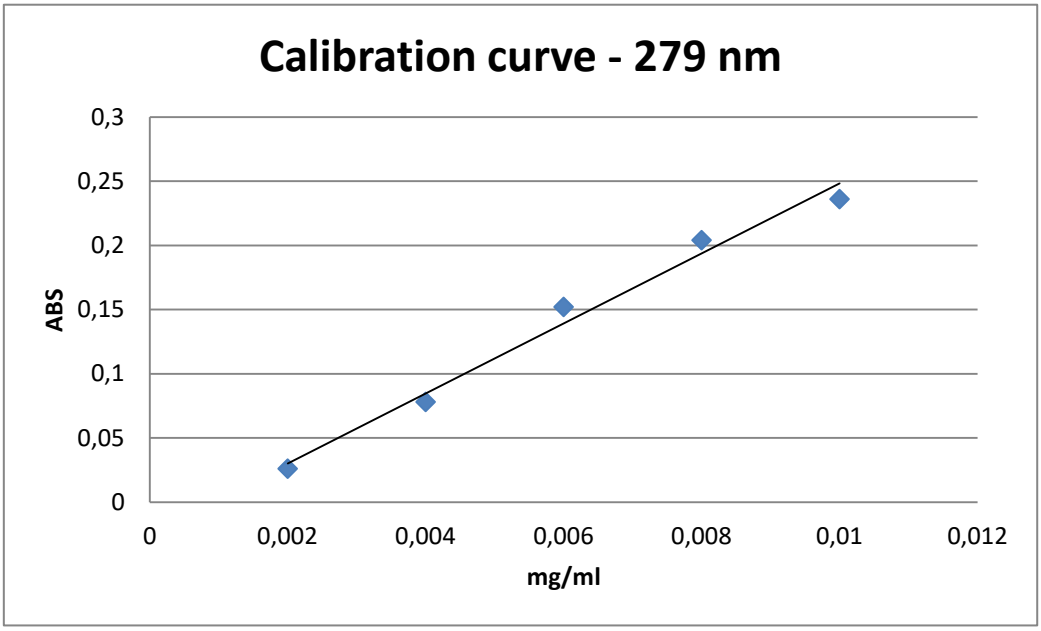


Figure 24: Calibration curve of 279 nm

$$y = 27.3x - 0.0246$$
$$R^2 = 0.9841$$

(25)

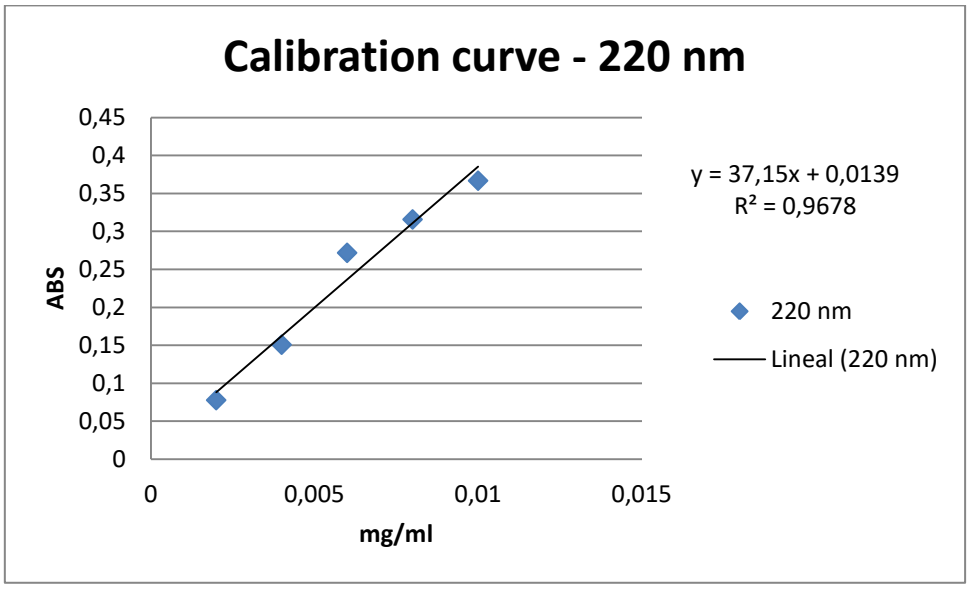


Figure 25: Calibration curve of 220 nm

$$y = 37.15x + 0.0139$$
$$R^2 = 0{,}9678$$

(26)

7.2.Microencapsulation

The method chosen for to manufacture the microcapsules of betacarothenes with chitosan has been Solvent Evaporation. On our first approach it is use only the active agent, the polymeric component and a dispersing agent. On the second approach it will be add the surfactant and the cross-linking agent on substitution of dispersant.

7.2.1. Previous calculations

On this solvent evaporation method it is use the type of emulsion $W_1/O/W_2$. On this first approach it will be use the following reagents: β-carotene, chitosan (high molar mass) and Polyvinyl alcohol (PVA). It will have a constant volume for all the process (until the last step) of 170 ml (10 ml for β-carotene, 10 ml for chitosan and 150 ml of PVA). For the second approach it will have a constant volume of 180 ml (10 ml for β-carotene, 10 ml for chitosan, 150 ml of Tween 20 and 10 ml of tannic acid).

First approach using chitosan

The W_1 (active agent) is formed by β-carotene with 1-propanol (as a solvent) because the active agent is soluble on water and that fact would difficult the formation of microcapsules. As the active agent is the key of the operation, the concentration of it have to be known and controlled all the time. On this manufactured process will be 0.1 mg/ml:

$$170\ ml * \frac{0.1\ mg/ml}{X} = 10\ ml \rightarrow X = \frac{170 * 0.1}{10} \rightarrow X = 1.7 \frac{mg}{ml}$$

(27)

With the concentration of the mother solution, it can be known the amount of β-carotene for made the mother solution on a 100 ml volumetric flask:

$$1.7 \frac{mg}{ml} * 100ml = 170\ mg\ of\ \beta - carotene$$

(28)

The O (polymer) is formed by *chitosan with dichloromethane (DCM) (as a solvent) for the same reason explained before. It will be use a molar relation of 1:1, then the concentration of this polymer on solution should be:*

$$0.1 \frac{\text{mg } \beta - \text{carotene}}{\text{ml}} * \frac{1\text{g}}{1000\text{ mg}} * \frac{1\text{ mol } \beta - \text{carotene}}{536.826\text{ g } \beta - \text{carotene}} * \frac{1\text{ mol chitosan}}{1\text{ mol } \beta - \text{carotene}} * \frac{288\text{ g chitosan}}{1\text{ mol chitosan}} * \frac{1000\text{ mg}}{1\text{g}} = 0.54\ \frac{\text{mg chitosan}}{\text{ml}}$$

(29)

Following the same steps on the previous part, it can be calculate the concentration that a mother solution should have:

$$170\ ml * \frac{0.54\ mg/ml}{X} = 10\ ml \rightarrow X = \frac{170 * 0.54}{10} \rightarrow X = 0.918 \frac{mg}{ml}$$

(30)

With the concentration of the mother solution, it can be known the amount of chitosan for made the mother solution on a 50 ml volumetric flask:

$$0.918\frac{mg}{ml} * 50ml = 45.9\ mg\ of\ chitosan$$

(31)

The W_2 (dispersant) is formed by *PVA with distillate water (as a solvent). It is use 3.06 g of PVA for 150 ml of distillate water.*

Second approach using chitosan

On this part should be calculate only the amount of product for the Tween 20 and the Tannic acid:

The W_2' (dispersing agent) is formed by Tween 20 with distillate water (as a solvent). It uses a rank of concentration of 0.1 – 0.6 g for 400 ml (0.25 mg/ml – 1.5 mg/ml). For this second approach, it will be use the high concentration of the rank and add to the emulsion 150 ml, then:

$$1.5\ \frac{\text{mg}}{\text{ml}} * 150\ \text{ml} = 225\ \text{mg of Tween 20}$$

(32)

For the Tannic acid it was used a concentration of 10% (W/V) on the solution and distillate water (as a solvent). For a total volume of 180 ml (10 of them are of Tannic Acid) should make a solution of 18 mg per 10 ml.

$$10\ \%\frac{\text{W}}{\text{V}} \rightarrow \frac{10\ \text{mg}}{100\ \text{ml}} = 0.1\ \frac{\text{mg}}{\text{ml}} \rightarrow 0.1\frac{\text{mg}}{\text{ml}} * 180\ \text{ml} = 18\ \text{mg of Tannic acid}$$

7.2.2. *Laboratory experiment*

Manufacturing microcapsules using different coating materials (block 1)

On this part, it was use the laboratory protocols give by O. Perez, one PhD student from the university. The explanation below is split depending the coating material used:

The solution 1 was a mixture of 120 mg of eudragit (coating material) with 6 ml of acetone using a beaker of 10 ml and the solution2 was a mixture of 50 mg of β-carotene (active component) with 7 ml of acetone using a beaker of 10 ml. Both solutions were stirring using an Ultra-Turrax T25 (300 rpm) until the solids were dissolved. Then mix both solutions on a beaker of 20 ml, add 10 mg of zinc stearate and stirring throughout 20 minutes (500 rpm). While the solution 1 and 2 have been stirring, to make the solution 3 it was use a beaker of 100 ml mixing 67 ml of paraffin wax and 7.5 ml of hexane. After 20 minutes, pour the emulsion

to the solution 3 and stirring with the Ultra-Turrax T25 (15600 rpm) during 10 minutes. Afterwards change the starring for a blade stirring (low rate) and left for 4h.

The solution 1 was a mixture of 250 mg of PLA (coating material) with 10 ml of DCM using a beaker of 25 ml and the solution2 was a mixture of 50 mg of β-carotene (active component) with 10 ml of DCM using a beaker of 25 ml. Both solutions were stirring using an Ultra-Turrax T25 (300 rpm) until the solids were dissolved. Then mix both solutions on a beaker of 50 ml, stirring throughout 20 minutes (500 rpm). While the solution 1 and 2 have been stirring, to make the solution 3 it was use a beaker of 200 ml mixing 150 ml of water, 250 mg of PVA and 2 ml of SMA and stirring with a magnetic stirrer (medium rate). After 20 minutes, pour the emulsion to the solution 3 and stirring with the Ultra-turrax T25 (15600 rpm) during 10 minutes. Afterwards change the starring for a blade stirring (low rate) and left for 4h.

The solution 1 was a mixture of 250 mg of PLGA (coating material) with 10 ml of DCM using a beaker of 25 ml and the solution2 was a mixture of 50 mg of β-carotene (active component) with 10 ml of DCM using a beaker of 25 ml. Both solutions were stirring using an Ultra-Turrax T25 (300 rpm) until the solids were dissolved. Then mix both solutions on a beaker of 50 ml, stirring throughout 20 minutes (500 rpm). While the solution 1 and 2 have been stirring, to make the solution 3 it was use a beaker of 200 ml mixing 150 ml of water and 2 ml of SMA and stirring with a magnetic stirrer (medium rate). After 20 minutes, pour the emulsion to the solution 3 and stirring with the Ultra-turrax T25 (15600 rpm) during 10 minutes. Afterwards change the starring for a blade stirring (low rate) and left for 4h.

The solution 1 was a mixture of 4 g of Gel-Arab Gum (coating material) with 50 ml of distillate water using a beaker of 100 ml, the solution 2 was a mixture of 10 mg of a solution 1% of β-carotene with acetone (active component) with 50 ml of distillate water using a beaker of 10 ml. Both solutions (solution 1 at 50 ºC) were stirring using an Ultra-Turrax T25 (300 rpm) until the solids were dissolved. While was the solution 1 and 2 prepare, heat the bath's reactor at 50. Then add both solutions to the reactor and, using a blade stirring (600 rpm), mix it and keep the pH at 4.26. Thereby use HCl for keep the pH constant. After 90 minutes, decrees the bath's temperature to 8ºC. After 1h adjust the pH, using NaOH, to 9.27. Afterwards add 1g of glutaraldehyde and let for 90 minutes the emulsion on a continuous stirring (600 rpm).

Making the emulsions using chitosan as a coating material (block 2)

The first step was made the mother solution of W_1 and O. For that purpouse, measure the amount of reagent need (β-carotene for the first one and chitosan for the second).So, using a breaker, made the solution with the reagent and a solvent (1-propanol for the first one and

DCM for the second one) stirring it with a magnetically starring (medium velocity) until the reagent was dissolved. For to make the solution of dispersing agent the dispersant solution, follow the same steps used for the other with the difference on the magnetically stirring step (medium rate and 8h waving).

First approach for made the microencapsulation

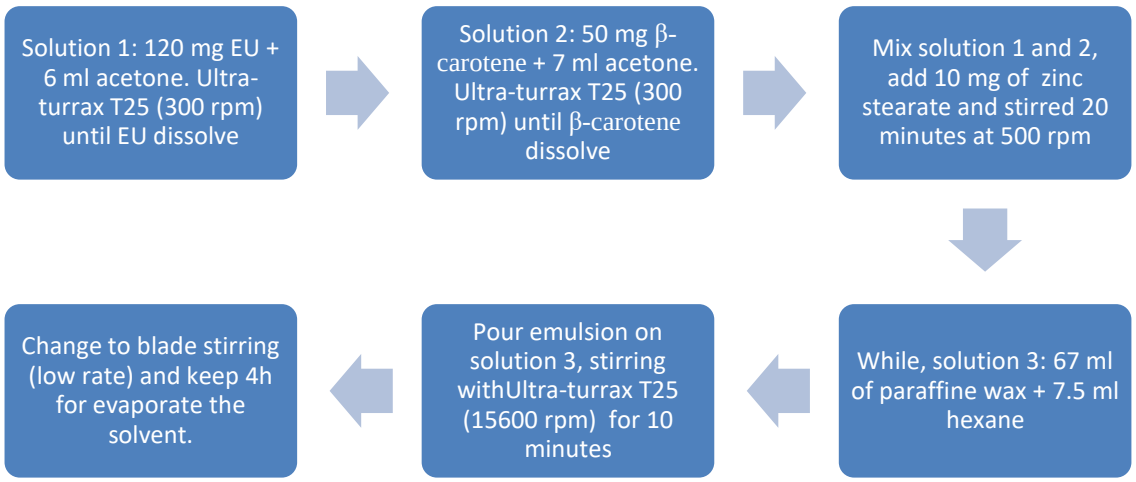
Extract 10 ml of each one and we add to a breaker of 50 ml at least. Mix this solution using an Ultra-turrax T25 (9000 rpm) for 15 minutes on a bath at 4ºC. While the solution was stirred, made the solution W_2. After 15 minutes, pass the emulsion W_1/O to a 500 ml beaker, add 150 ml of W_2 there and, using the ultra-turrax T25 (16000 rpm), mix all for 20 minutes. At the end, let the solution 24h on a continuous agitation (using a magnetic starring, low velocity) for let all the solvent evaporate.

Second approach for made the microencapsulation

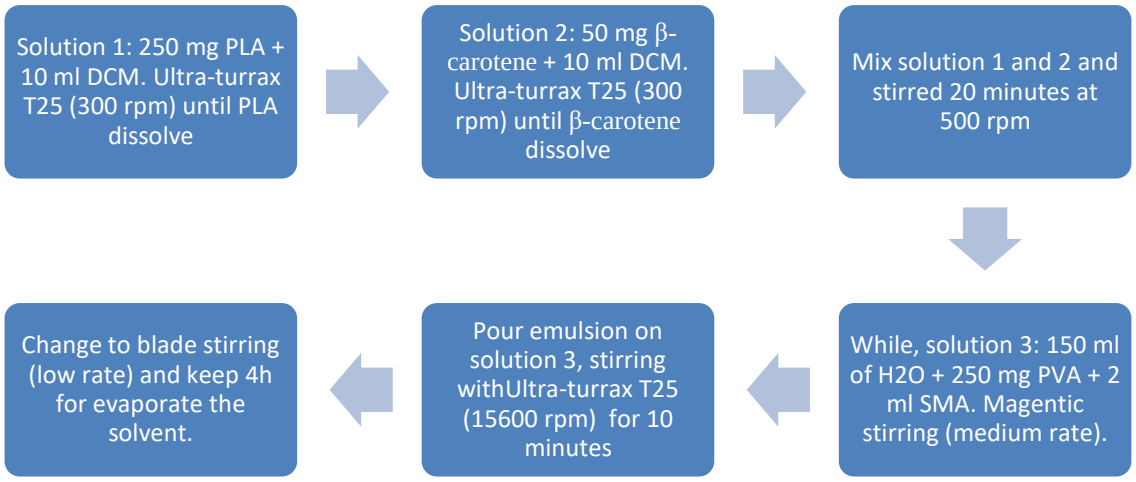
We extract 10 ml of each one and add to a breaker of 50 ml at least. Mix this solution using an ultra-turrax T25 (9000 rpm) for 15 minutes on a bath at 4ºC. In the meantime, made the solution W_2' with a beaker of 250 ml and starring the solution with a blade agitator (medium velocity). When the emulsion W_1/O is ready, pass the solution to the beaker where the solution W_2' had been stirred and increases the velocity of the blade agitator. After 15 minutes add the Tannic acid, decrease the velocity to "low velocity" and let them 24h for evaporate the solvent.

7.2.3. Bloc diagram

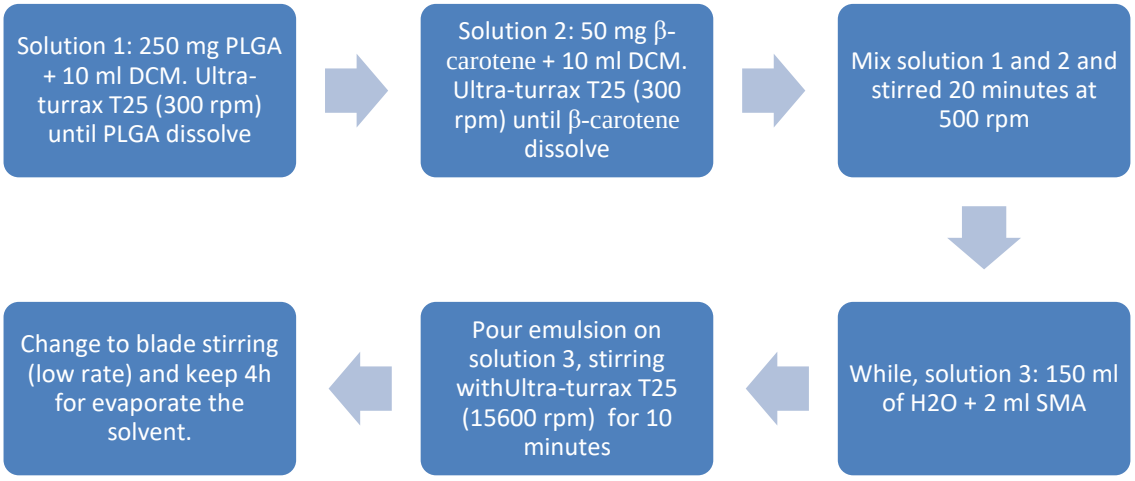
Manufacturing microcapsules using eudragit



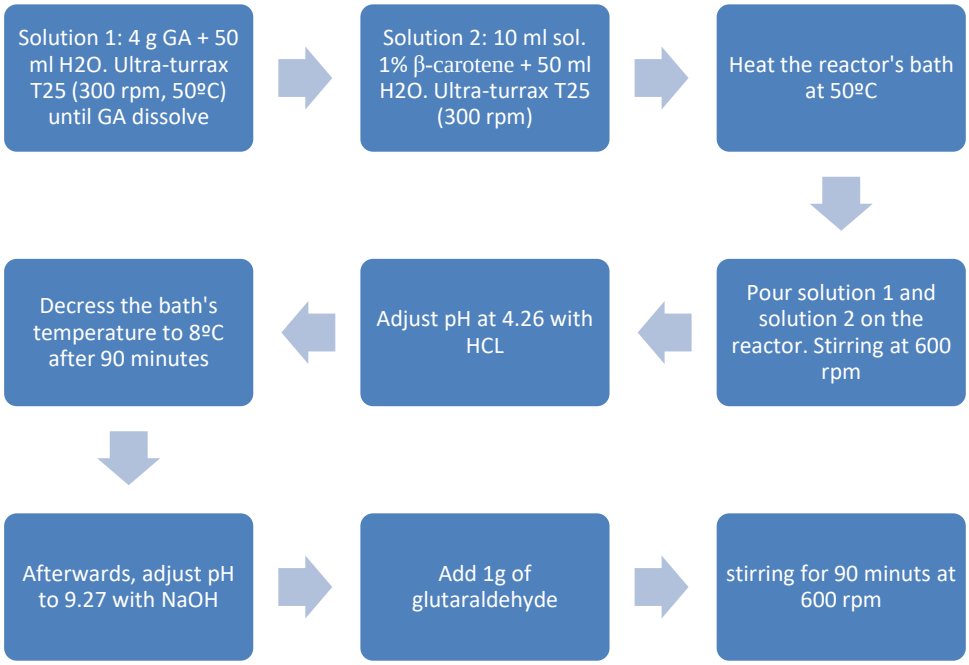
Manufacturing microcapsules using PLA



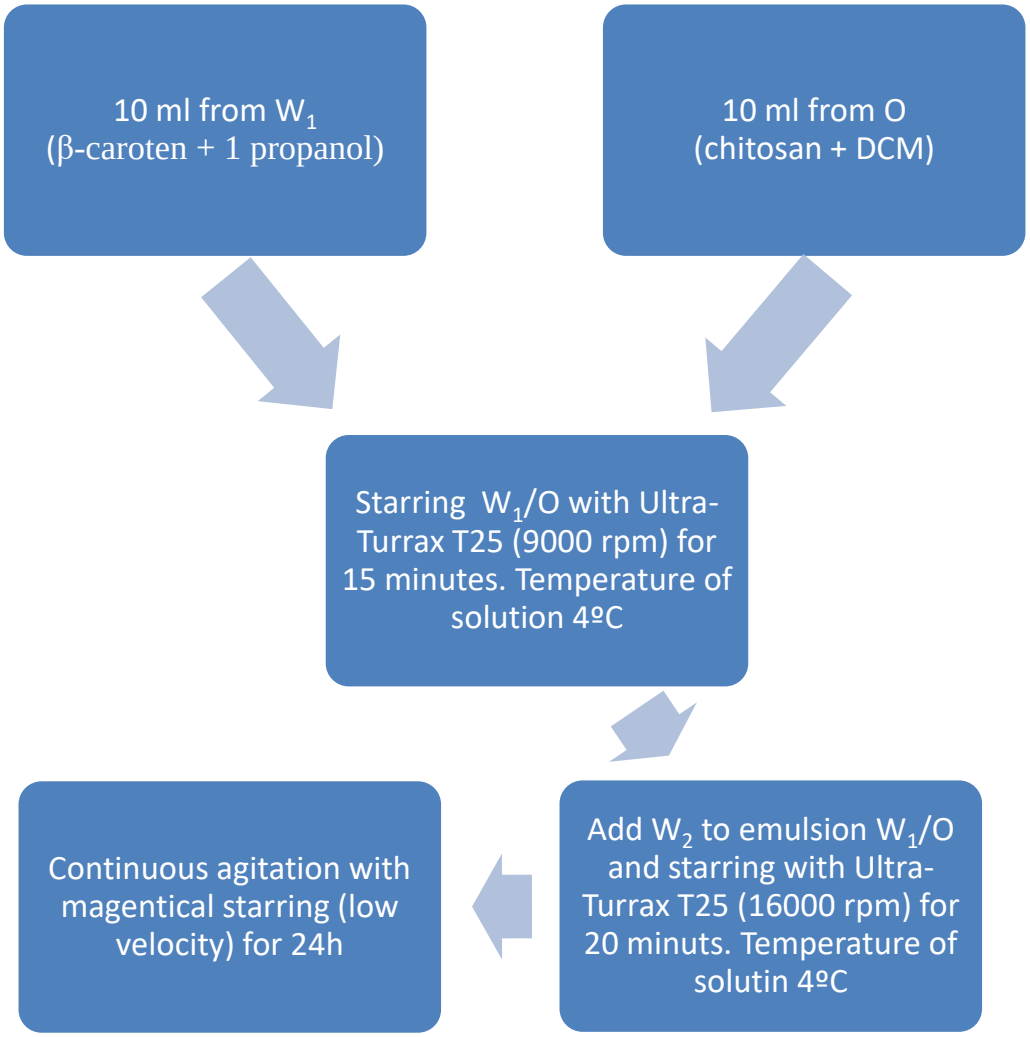
Manufacturing microcapsules using PLGA



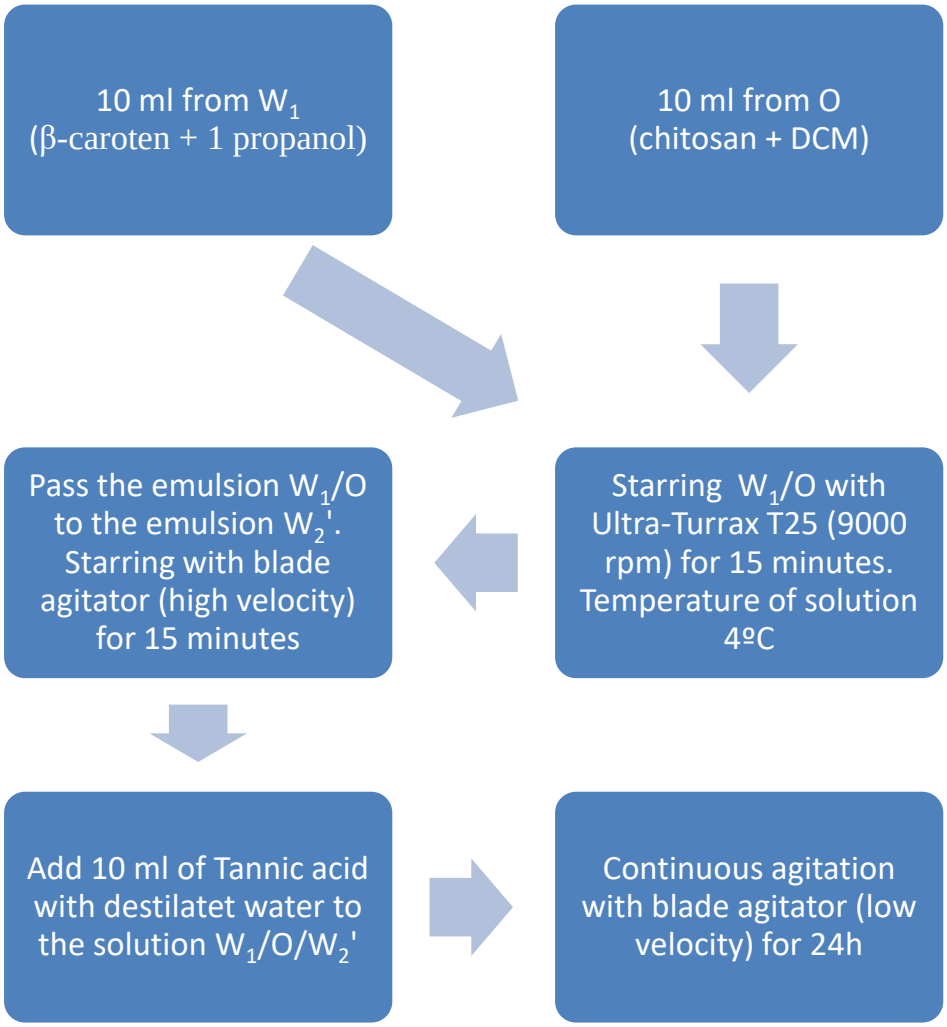
Manufacturing microcapsules using Gel-Arabic gum



First approach for made the microencapsulation



Second approach for made the microencapsulation



7.2.4. Photos of the process

Figure 26: Ultra-turrax T25 with solution W_1/O

Figure 27: First approach during the evaporation step

Figure 28: Solution of first approach after the process

7.3.Drug release

In order to study the mechanisms of drug-delivery from microcapsules, its application into two different substrates has been done: cotton (COT) and polyester (PES). The aim of this application remains in the fact that microcapsules isolated would tend to aggregate in ionic medium. Therefore, results would be not accurate enough to describe, properly the phenomenology involved. However, the use of different chemical-based tissues, will allow studying the retention potential of the microencapsulated system, and seeing if there's a "reservoir effect".

7.3.1. Previous calculation

When do the drug delivery it should have a relation between the weight of the tissue and the volume of the solution (1/40). If do not accomplish with this relation the drug delivery results will not be a semi-infinite bath, and therefore, diffusion equations will be not applicable. Besides, on our test it extracts 10 samples (on a different times) of 1 ml each one. With this information, it is possible to calculate the weight of tissue needed:

$$1\ ml\ extracted * 10\ extrations = 10\ ml\ of\ samples$$

(33)

This is the minimum amount of solution that will be extract during the drug delivery test. With that, it is possible to calculate the minimum weight for our tissue sample:

$$\frac{1\ g}{40\ ml} = \frac{X}{10\ ml} \rightarrow X = \frac{10\ g * ml}{40ml} \rightarrow X = 0.25g$$

(34)

7.3.2. Experimental process

First of all it is necessary to made two samples, one for each tissue, those weight must be higher than 0.25g. When the samples are done, impregnate those samples with microcapsules of β-carotene's solution. Left those samples for 8h until dry and then measure again the weight for know the amount of microcapsule there. When the samples are ready, the drug delivery test can begin.

As was explain on the previous section, extract 9 samples for the solutions of the block 1 and 10 samples from the solution of the block 2. On the following table it is show when we have to extract those samples:

Timing (minute)								
1	3	5	10	15	30	45	60	3600

Table 13: Timing of sample's extraction for block 1

Timing (minute)									
1	3	5	7	10	15	30	45	60	120

Table 14: Timing of sample's extraction for block 2

The drug delivery test has to be at 37 ºC (the average temperature of human skin) for this reason it is use a water-bath for reach this temperature on the solution (*Figure 29*). Before start with the test, should be get ready all the test tubes for save the samples from the drug delivery's solution.

Figure 29: Erlenmeyer inside Memmert

Use an Erlenmeyer of 50 ml and add 30 ml of physiological serum with the weave sample. Put inside the thermostated water bath (Memmert, *Figure 18*) and start extraction samples following the *Table 12* or *Table 13*. Every time it is extract 1 ml from the drug delivery's solution add 1 ml of physiological serum for not change the total volume of the solution.

When all the samples are done, those are to get prepare for read the absorbance. Diluted them (1:25) with 1-propanol (the same solvent used on the calibration curve) using a volumetric flask of 25 ml.

7.3.3. Results

Manufacturing microcapsules with different coating materials (block 1)

For release the drug delivery of the microcapsules made with Eudargit, PLA, PLGA and Gel-Arabic gum it was used as a textile the COT samples. On the following table it show the weight of the weave samples before and after the impregnation of microcapsules:

Coating material used	Weight before (mg)	Weight after (mg)
PLA	450	461
PLGA	418	483
EU	438	651
GA	516	522

Table 15: Weight before and after the impregnation

Manufacturing microcapsules with chitosan (block 2)

The following table show the weight of the weave samples before and after the impregnation of microcapsules:

Wave type	Weight before (mg)	Weight after (mg)
COT	473	475
PES	416	416

Table 16: Weight before and after the impregnation

The sample of PES does not change their weight because the chemical characteristics of tissue (hydrophobe) cannot absorb a more hydrophilic microcapsules and, therefore, do not let the microcapsules adhere. Nevertheless, may be microcapsules only on the COT sample. Spite of that, the drug delivery test should be done for the PES samples in case it have a low concentration of microcapsules (our weight balance can not read under the milligrams).

Start with the absorbance test and obtained lectures on the frequency 481 nm and 479 nm (see Figures 30 and 31) on the COT test but did not obtain any lecture on the PET test (this confirm our hypothesis). The results obtained on the COT test are showed on the following table:

Time (minute)	481 nm	479 nm
1	0.01	0.012
3	0.035	0.041
5	0.0078	0.009
7	0.002	0.002
10	0.002	0.002
15	0	0
30	0	0
45	0	0
60	0	0
120	0	0

Table 17: ABS results of COT test

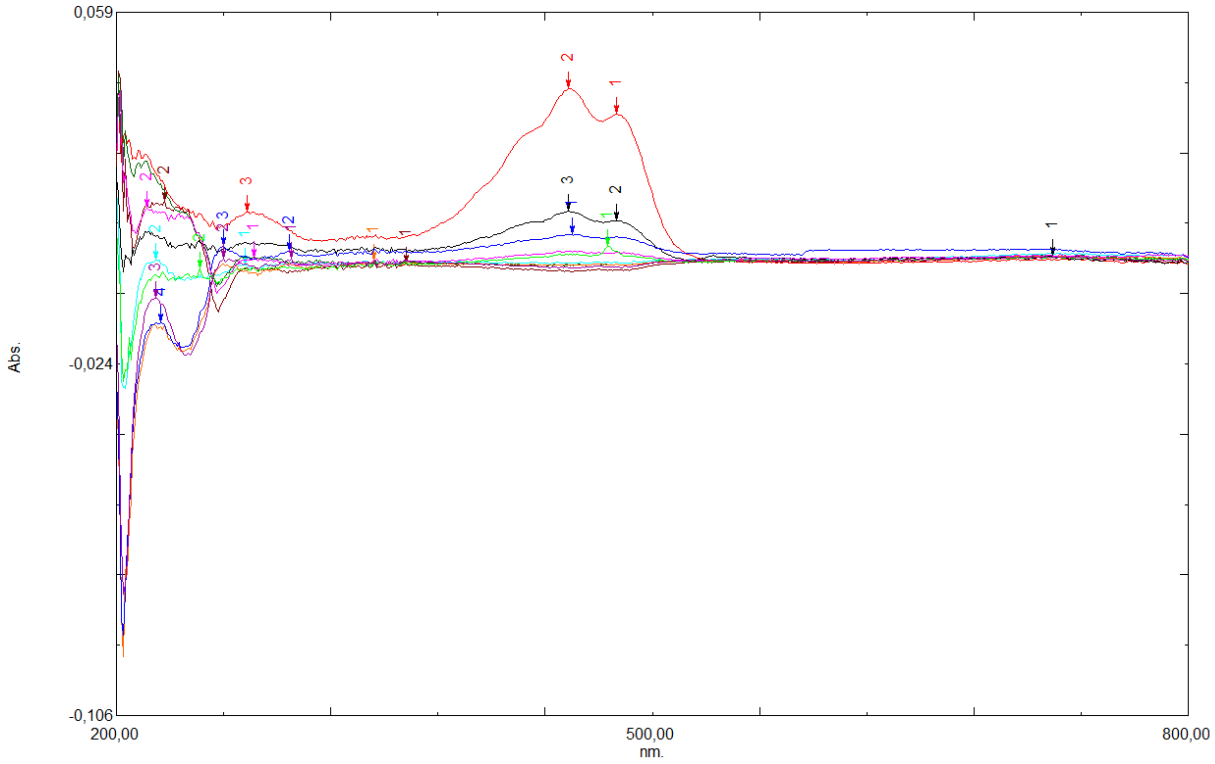


Figure 30: All absorbance results from COT test

The results from drug delivery test show that, after 15 minutes, there are no more microcapsules of β-carotene. This is due to the effect of the temperature to the β-carotene. As a consequence of the degradation temperature of the β-carotene, after a few minutes the β-carotene was demoting.

The result from the drug delivery test on PES is show on the following table:

Time (minute)	481 nm	479 nm
1	0	0
3	0	0
5	0	0
7	0	0
10	0	0
15	0	0
30	0	0
45	0	0
60	0	0
120	0	0

Table 18: ABS results of PES test

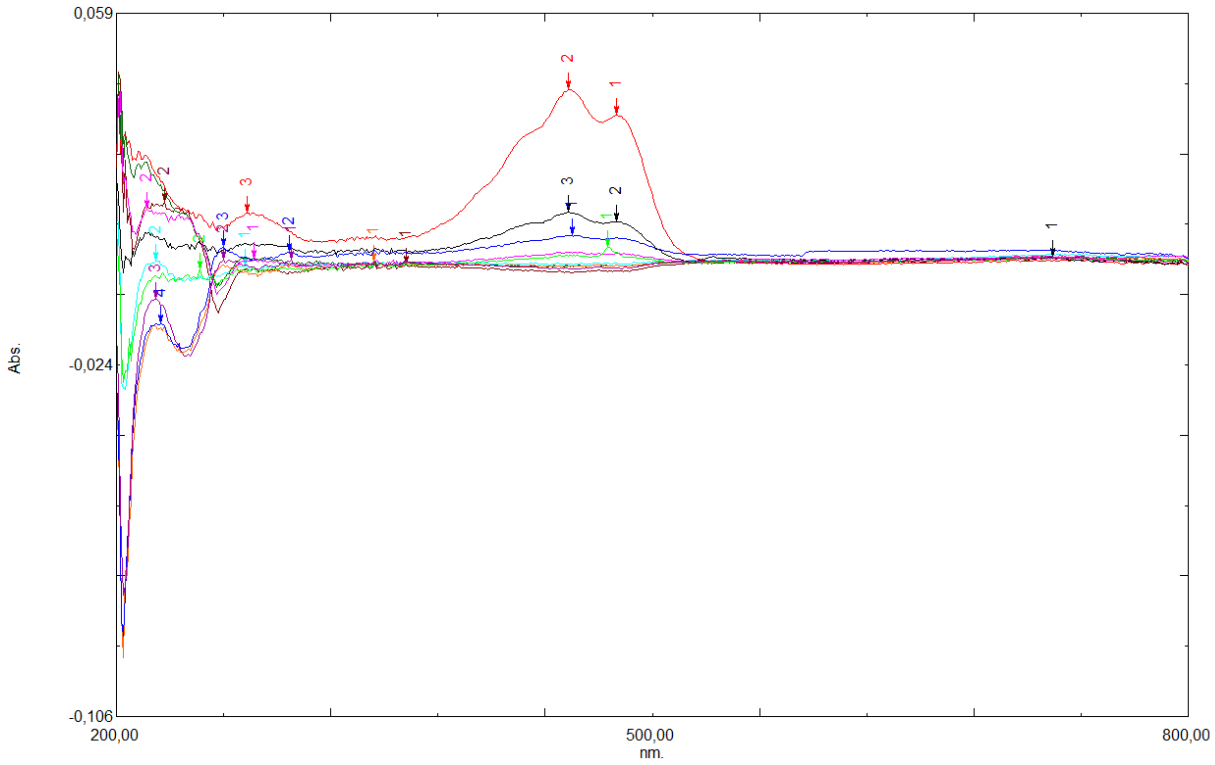


Figure 31: All absorbance results from COT test

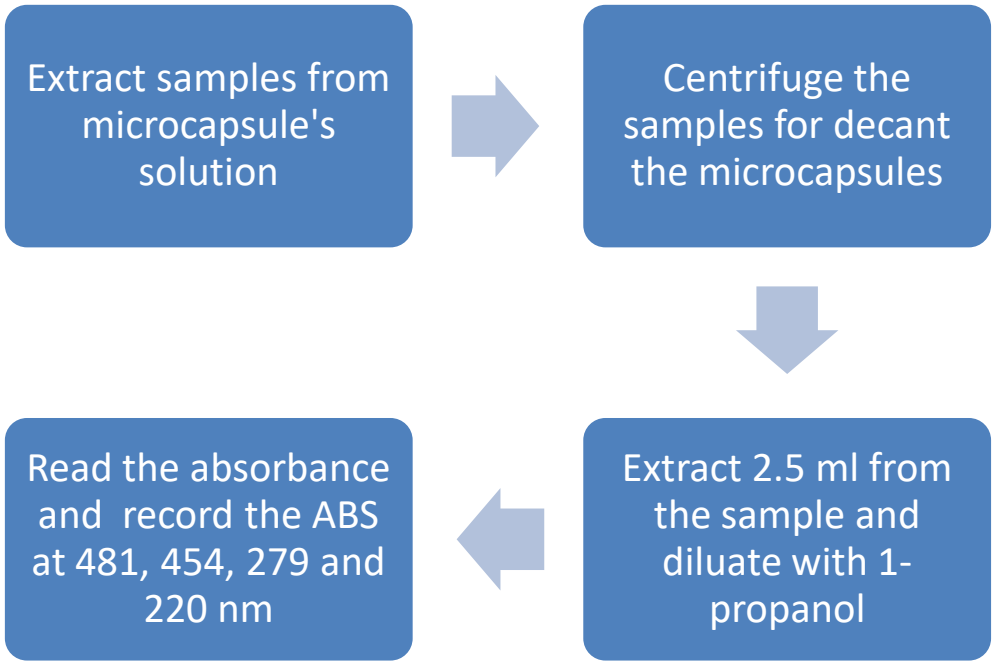
7.4.Yield

7.4.1. Preparation of the samples

It is extracted several samples from the microcapsule's solution and, using a centrifuge, we decant the microcapsules from the supernatant solution. This is done for leave only the excess of β-carotene on the solution. After a while it is possible to see (on the bottom) the microcapsules, if not keep with the centrifugation until this situation success.

Now, extract 2.5 ml (it is use a dilutee's relation of 1:10 form the original sample) of the sample and it is pass to a volumetric flask of 25 ml. We full fill it with 1-propanol. Before start with the absorbance readings it should been ready four different samples for each approach.

7.4.2. Bloc diagram



7.4.3. Results

First approach

On the first approach, the absorbance at 279 nm and 220 nm it does not necessary to be read. This is because, on the microcapsule's solution, it does not have Tween 20. The measurement of the absorbance is showed on the next table:

Sample	481 nm	454 nm
1	0.53	0.61
2	0.48	0.579
3	0.506	0.541
4	0.445	0.513

Table 20: Absorbance form the first approach

Using the equations obtained with the calibration curve, it can be obtained the yield of the first approach:

Sample	Concentration (mg/ml) diluted		Concentration (mg/ml)		Yield (%)	
	481 nm	454 nm	481 nm	454 nm	481 nm	454 nm
1	0.00651	0.00649	0.06512	0.06485	34.88	35.15
2	0.00589	0.00615	0.05890	0.06154	41.10	38.46
3	0.00621	0.00575	0.06213	0.05748	37.87	42.52
4	0.00545	0.00545	0.05454	0.05448	45.46	45.52

Table 21: Yield on the first approach

With the first approach, it is obtained a yield of 40.12%. This result is good and promising because it was not used the surfactant and cross-linking agent (two components that help with the creation of microcapsules).

Second approach

Maybe the Tween 20 did not react completely and it can remain some of them on the microcapsule's solution. Therefore it should be read the absorbance at all the frequencies. The measurement of the absorbance is showed on the next table:

Sample	481 nm	454 nm	279 nm	220 nm
1	0.202	0.236	0.538	1.071
2	0.199	0.230	0.523	1.045
3	0.2	0.233	0.532	1.062
4	0.194	0.228	0.520	1.031

Table 22: Absorbance form the second approach

If it is done a quick read of these lectures, the results from 279 nm and 220 nm are out or range and the results are not good. Spite of that, it must be calculate them and the results are:

Sample	Concentration (mg/ml) diluted		Concentration (mg/ml)		Yield (%)	
	279 nm	220 nm	279 nm	220 nm	279 nm	220 nm
1	0,02061	0,02738	0,20608	0,27378	-106.81	-173.72
2	0,02006	0,02775	0,20059	0,27755	-100.59	-177.55
3	0,02039	0,02821	0,20388	0,28213	-103.88	-182.13
4	0,01995	0.02845	0,19948	0,28454	-99.49	-184.55

Table 23: Yield on the first approach for 279 nm and 220 nm

The hypothesis done on before the yield calculation is right therefore we only use the absorbances lectures form 481 nm and 454 nm:

Sample	Concentration (mg/ml) diluted		Concentration (mg/ml)		Yield (%)	
	481 nm	454 nm	481 nm	454 nm	481 nm	454 nm
1	0.00243	0.00249	0.02429	0.02487	75.71	75.13
2	0.00239	0.00242	0.02391	0.02423	76.09	75.77
3	0.00240	0.00246	0.02404	0.02455	75.96	75.45
4	0.00233	0.00240	0.02329	0.02402	76.71	75.98

Table 24: Yield on the second approach

On the second approach, the average yield obtained is 75.84%. This result is very good because almost all the β-carotene was microencapsulate and this result is near the yield it can be find on the industrial word (around 85%).

7.5.Characterization

7.5.1. Physical characteristic

Physical characteristics of block 1

Due a problem on the equipments, it was no possible to run the test for the samples of PLGA and Gel-Arabic Gum. However, it was possible to run the test for the samples of Eudargit and PLA.

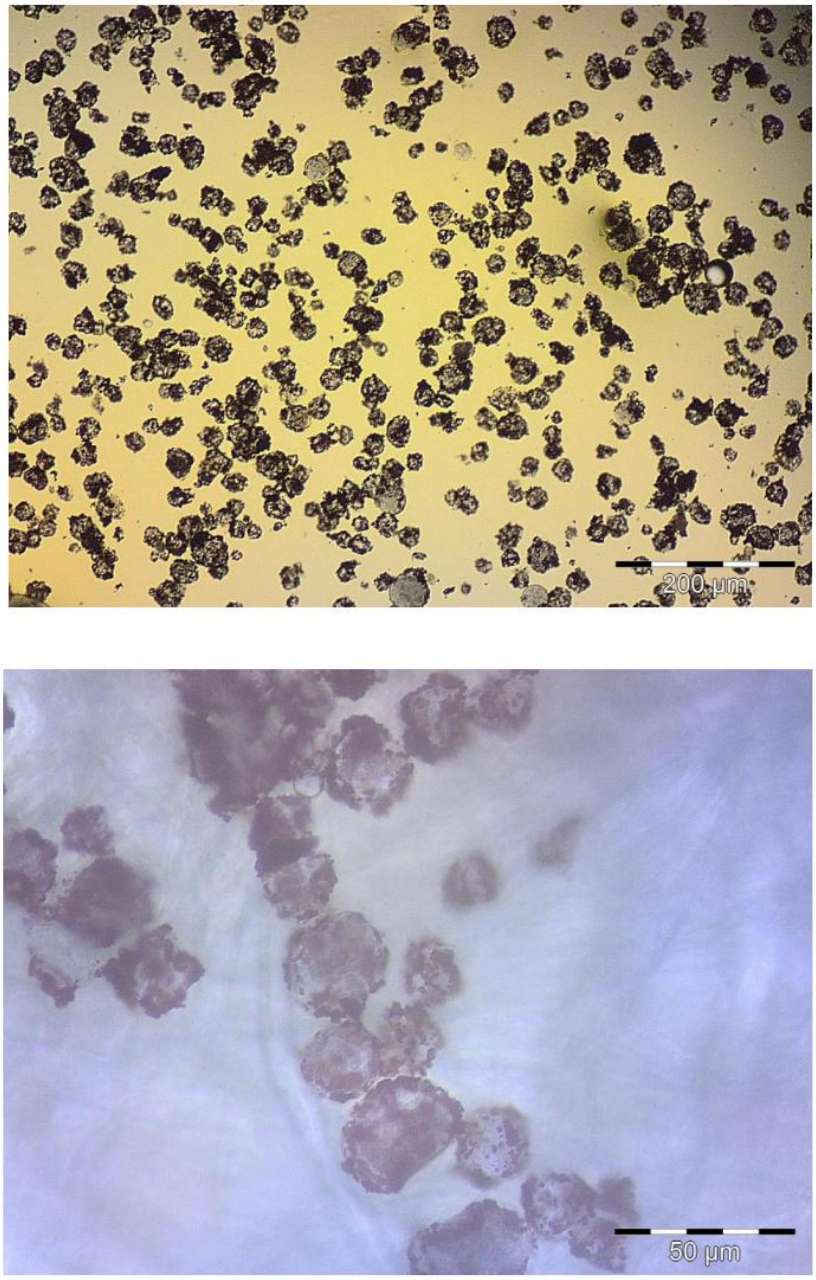
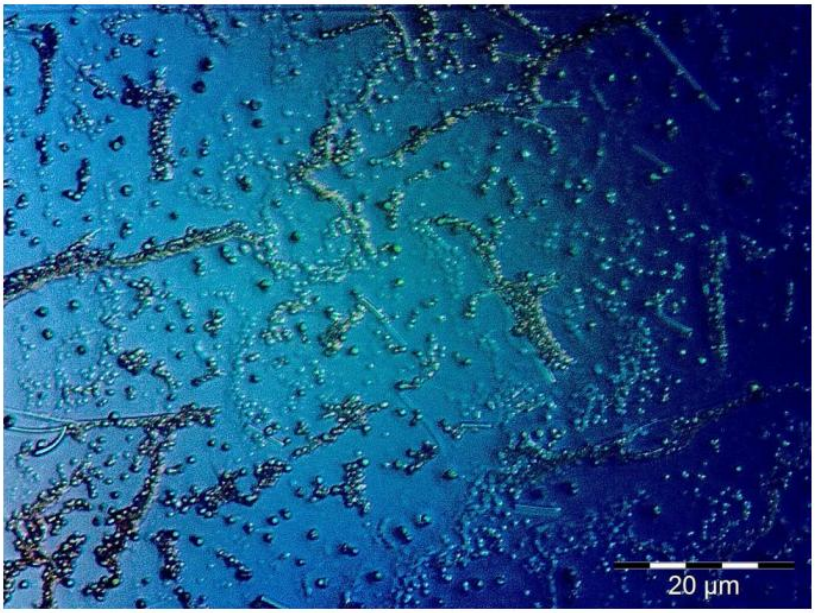


Figure 32: Microspheres of EU

Size	Agglomeration	Olfactory intensity	Color
20-35µm	No	------	White

Table 25: Characteristics of microcapsules of EU



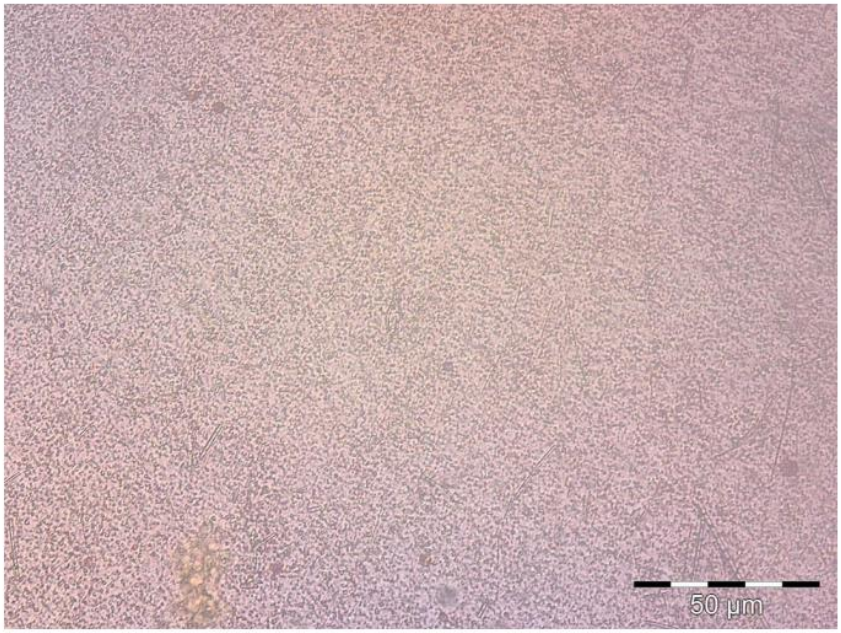


Figure 33: Microspheres of PLA

Size	Agglomeration	Olfactory intensity	Color
1 µm	No	------	Orange

Table 26: Characteristics of microcapsules of PLA

Physical characteristics of block 2

Using an optical microscope, it can be known the size of the microcapsules manufactured and the amount of them (always on the samples studied).

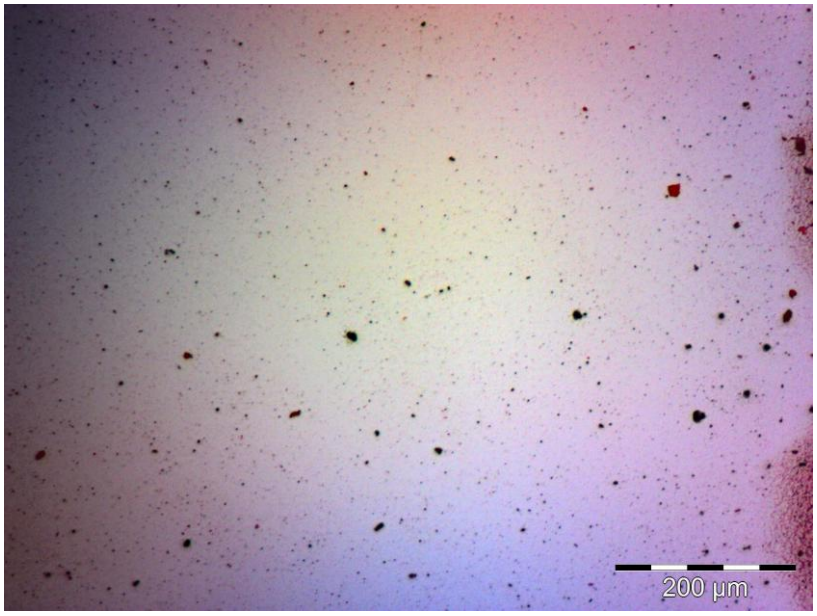


Figure 34: Image capture from the optical microscope, 5 x 0.1

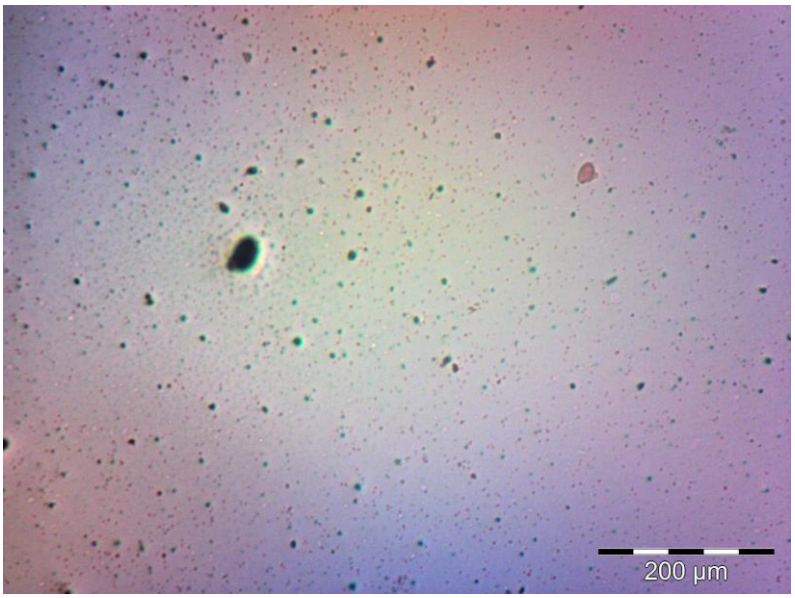


Figure 35: Image capture from the optical microscope, 50 x 0.75

Size	Agglomeration	Olfactory intensity	Color
6-16µm	No	------	White

Table 27: Characteristics of microcapsules of chitosan

7.5.2. Theoretical mechanism of drug realise

Drug realise of block 1

The results obtained on the drug delivery test were good enough as not to have to apply any correction factor. Below there is a table and a graphic with the results corresponding to the absorbance of 481 nm (this is due the results on this spectrum were much better than the results on 454 nm):

Time (min)	ABS	Concentration (mg/ml)	M (mol/l)	Mt/Minf	$\sqrt{\tau}$
0	0	0	0	0	0
1	0.121	0.516	9.609E-04	1.01592	1
3	0.125	0.548	1.021E-03	1.07942	1.73205081
5	0.1173	0.486	9.051E-04	0.95696	2.23606798
10	0.1177	0.489	9.113E-04	0.96348	2.64575131
15	0.1179	0.491	9.141E-04	0.96649	3.16227766
30	0.1179	0.491	9.141E-04	0.96649	3.87298335
45	0.121	0.516	9.609E-04	1.01592	5.47722558
60	0.116	0.476	8.858E-04	0.93655	6.70820393
3600	0.12	0.508	9.458E-04	1.00005	7.74596669

Table 28: Results of PLA

Time (min)	ABS	Concentration (mg/ml)	M (mol/l)	Mt/Minf	$\sqrt{\tau}$
0	0	0	0	0	0
1	0.0635	0.0524	9.759E-05	0.11217	1
3	0.1133	0.4541	8.458E-04	0.97224	1.73205081
5	0.114	0.4594	8.558E-04	0.98364	2.23606798
10	0.114	0.4594	8.558E-04	0.98364	2.64575131
15	0.114	0.4594	8.558E-04	0.98364	3.16227766
30	0.115	0.4675	8.708E-04	1.00090	3.87298335
45	0.114	0.4594	8.558E-04	0.98364	5.47722558
60	0.115	0.4675	8.708E-04	1.00090	6.70820393
3600	0.115	0.4675	8.708E-04	1.00090	7.74596669

Table 29: Results of PLGA

Time (min)	ABS	Concentration (mg/ml)	M (mol/l)	Mt/Minf	$\sqrt{\tau}$
0	0	0	0	0	0
1	0.123	0.5319	9.909E-04	1.04856	1
3	0.125	0.5481	1.021E-03	1.08033	1.73205081
5	0.122	0.5239	9.759E-04	1.03267	2.23606798
10	0.1165	0.4795	8.932E-04	0.94520	2.64575131
15	0.114	0.4594	8.558E-04	0.90557	3.16227766
30	0.114	0.4594	8.558E-04	0.90557	3.87298335
45	0.114	0.4594	8.558E-04	0.90557	5.47722558
60	0.122	0.5239	9.759E-04	1.03267	6.70820393
3600	0.12	0.5078	9.458E-04	1.00090	7.74596669

Table 30: Results of EU

Time (min)	ABS	Concentration (mg/ml)	M (mol/l)	Mt/Minf	$\sqrt{\tau}$
0	0	0	0	0	0
1	0.115	0.4675	8.708E-04	0.79162	1
3	0.122	0.5239	9.759E-04	0.88716	1.73205081
5	0.117	0.4836	9.008E-04	0.81891	2.23606798
10	0.114	0.4594	8.558E-04	0.77797	2.64575131
15	0.129	0.5803	1.081E-03	0.98270	3.16227766
30	0.1287	0.5777	1.076E-03	0.97831	3.87298335
45	0.114	0.4594	8.558E-04	0.77797	5.47722558
60	0.124	0.54	1.006E-03	0.91445	6.70820393
3600	0.132	0.6045	1.126E-03	1.02364	7.74596669

Table 31: Results of GA

From this point, and in order to obtain the mathematic model of the drug realise, we must graphic all the results on two different graphics:

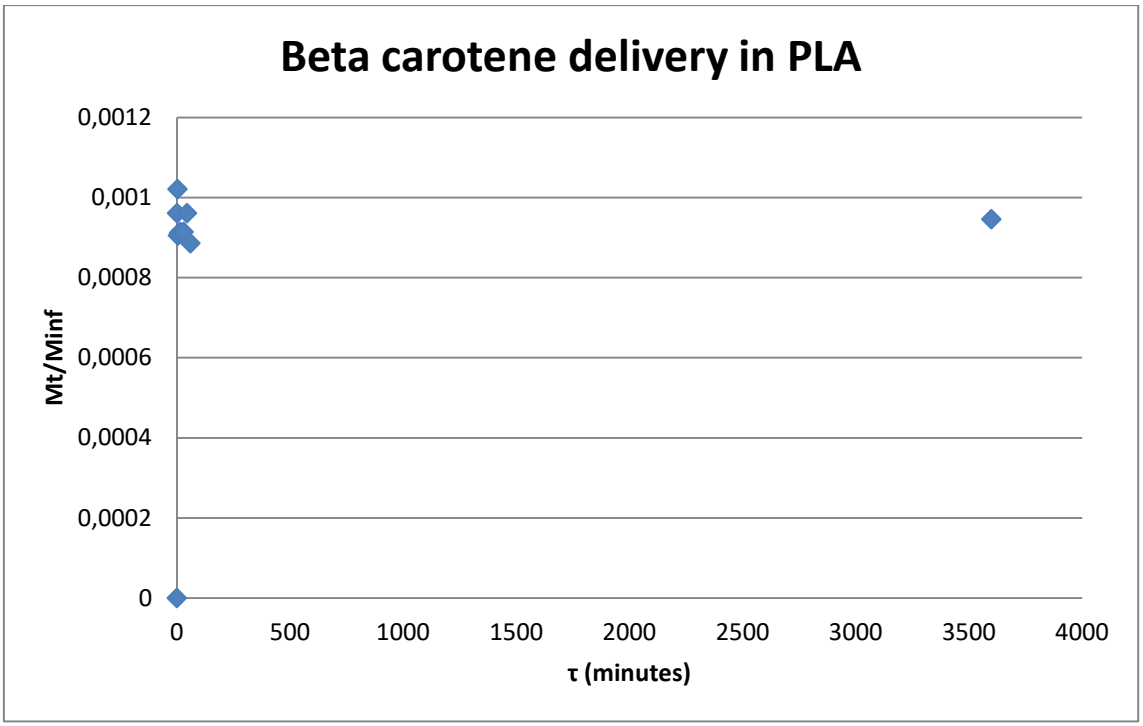


Figure 36

Just in order to see the accumulation of points in the first times of the delivery. is usual recommended to avoid the equilibrium point.

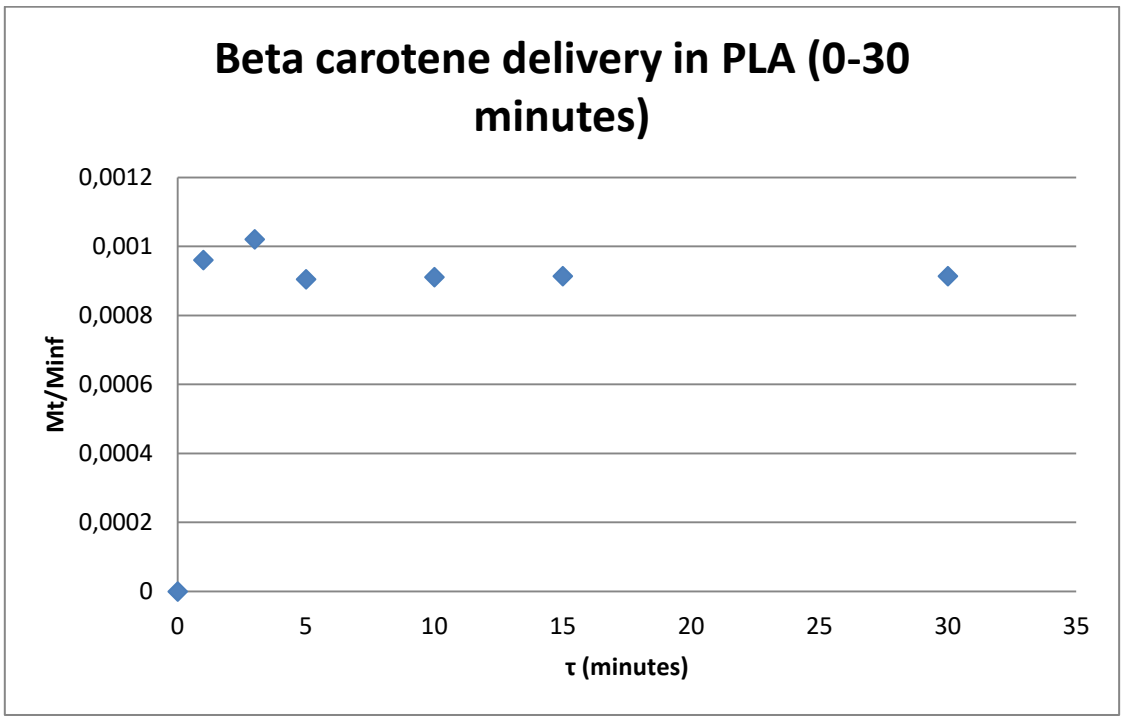


Figure 37

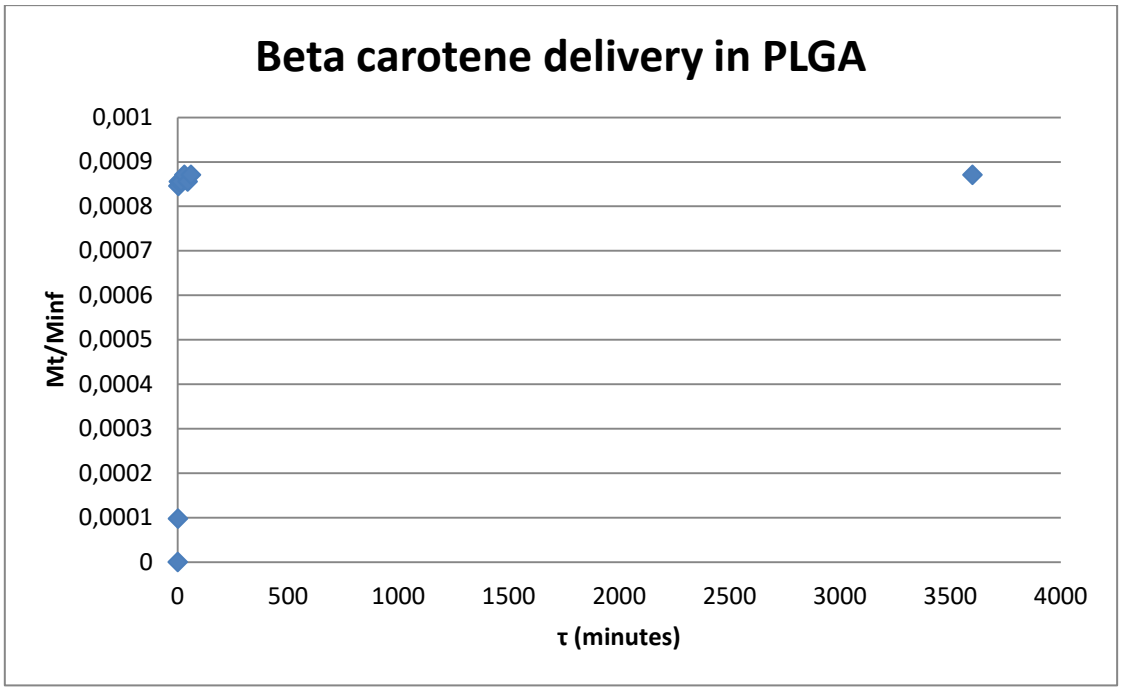


Figure 38

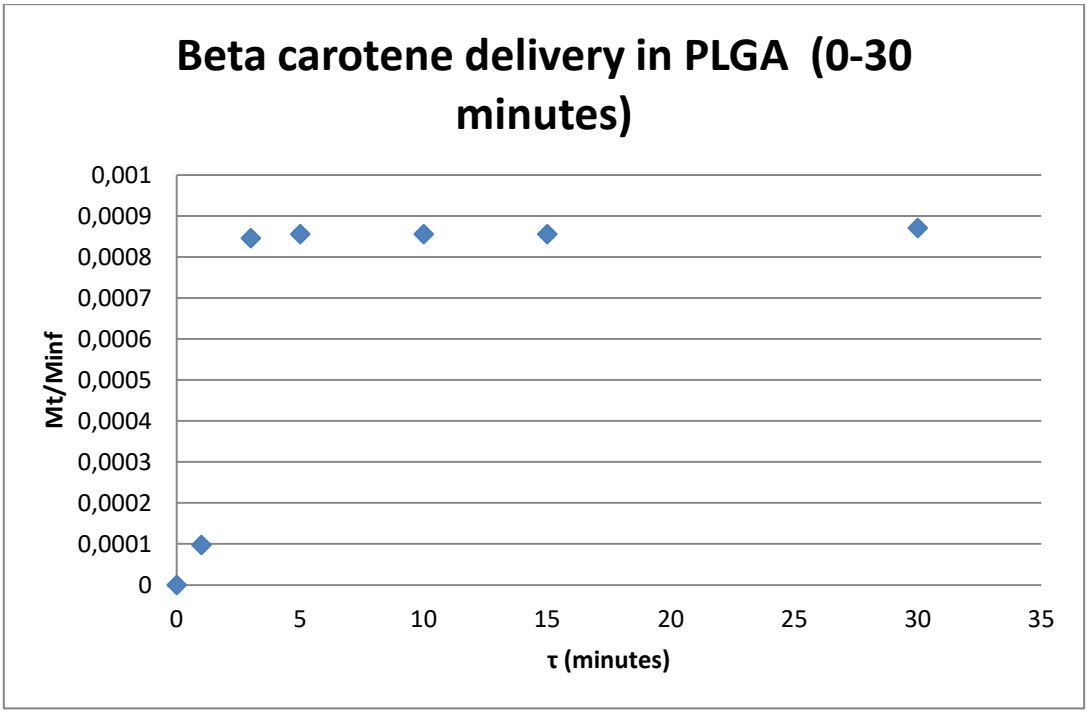


Figure 39

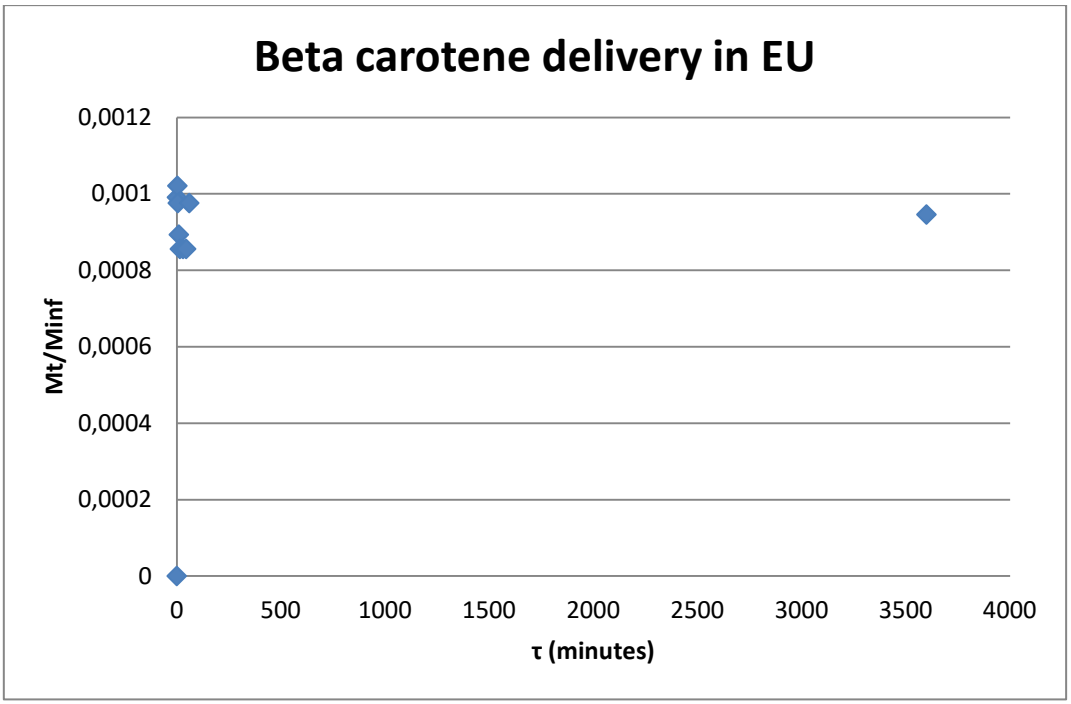


Figure 40

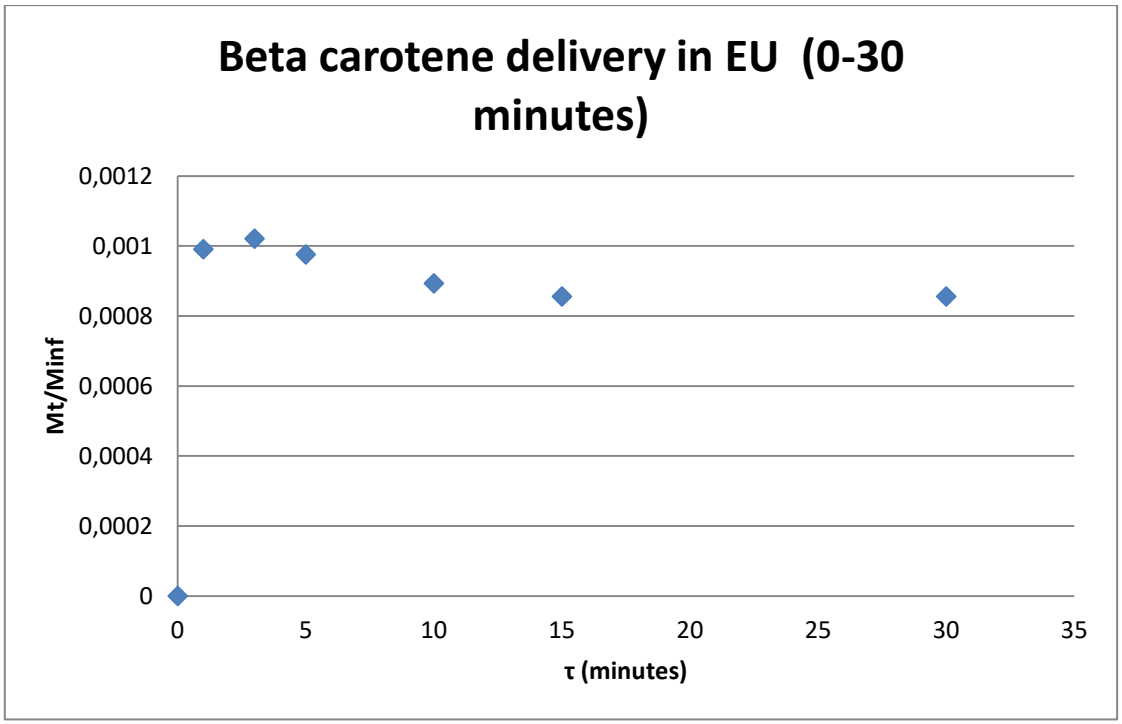


Figure 41

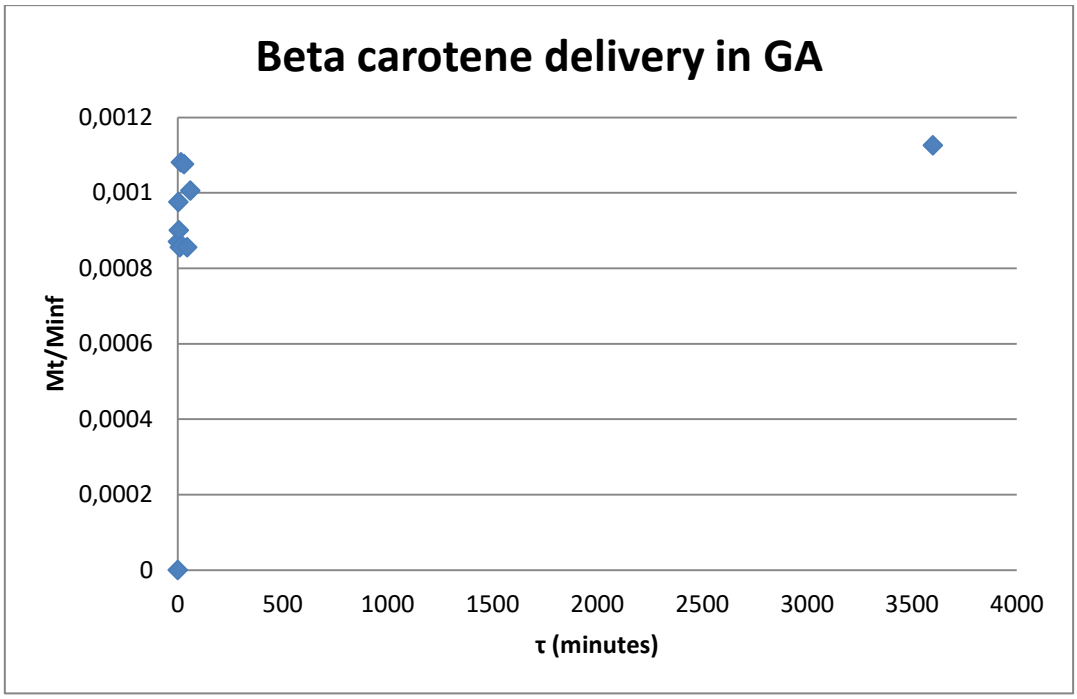


Figure 42

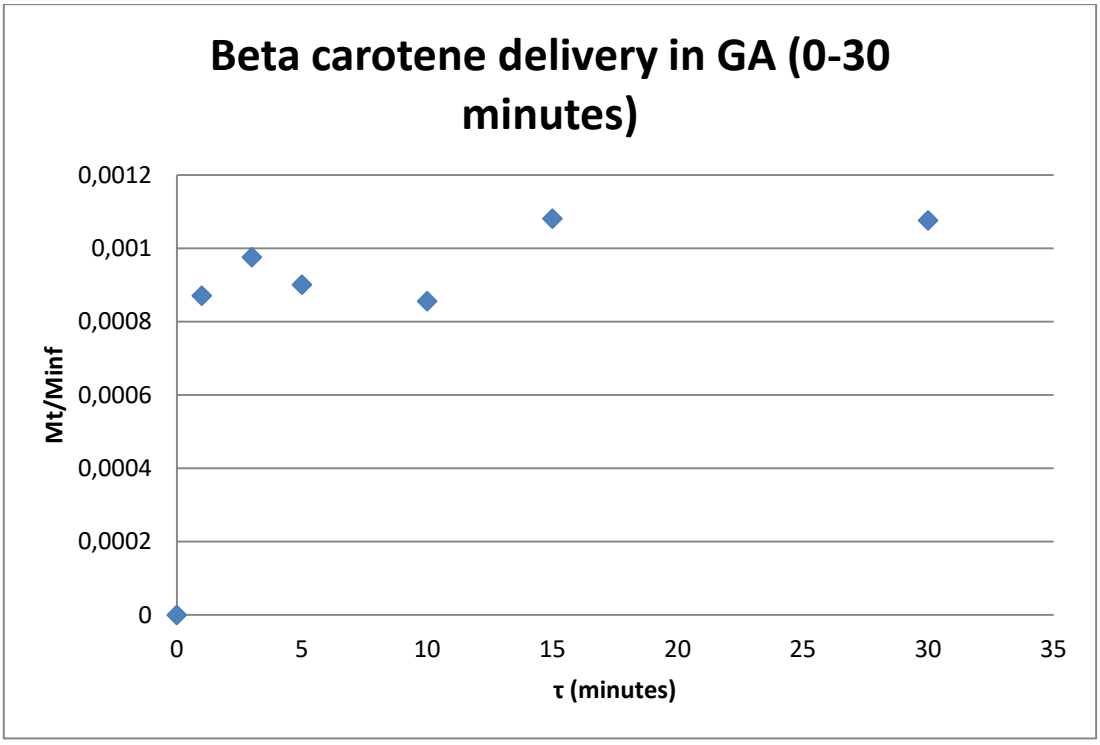


Figure 43

At this point it is necessary to use the equation of Krosenmeyer-Peppas (also knon as *Power law*) for calculate the valour of *n* and the *k* (equation 4.3). If the result of *n* is inside the Fick's parameters (see Figure 7). This let as continuous with the Higuchi's study.

With all the information extracted from the graphics, it can be calculated the valour of *n* and *K* on any point. The table 3 summarize this valour:

$$\log\frac{M_t}{M_{inf}} = \log \mathrm{K} + n \log \tau$$

(34)

$$\log\frac{M_t}{M_{inf}} - n \log \tau = \log \mathrm{K}$$

(35)

$$\left(\log\frac{M_t}{M_{inf}} - n \log \tau\right)_{minute\ t_2} = \left(\log\frac{M_t}{M_{inf}} - n \log \tau\right)_{minute\ t_2}$$

(36)

Coating material	*n*	*K (mol/l*minute)*
PLA	0.055	0.574
PLGA	1.96	0.538
EU	0.027	0.575
GA	0.103	0.507

Table 32: Results of Krossenmeyer-Peppas equation for block 1

Almost all the valour of *n* are under 0.5, thereby they have Fickian diffusion and let us to apply the higuhi equations. However, the *n* result of PLGA means that the drug realize is independent of time, regardless the geometry. Regardless this situation, this valour will not be considerate and beyond this point it is used the valour *n*=0.5 on the Higughi's equation.

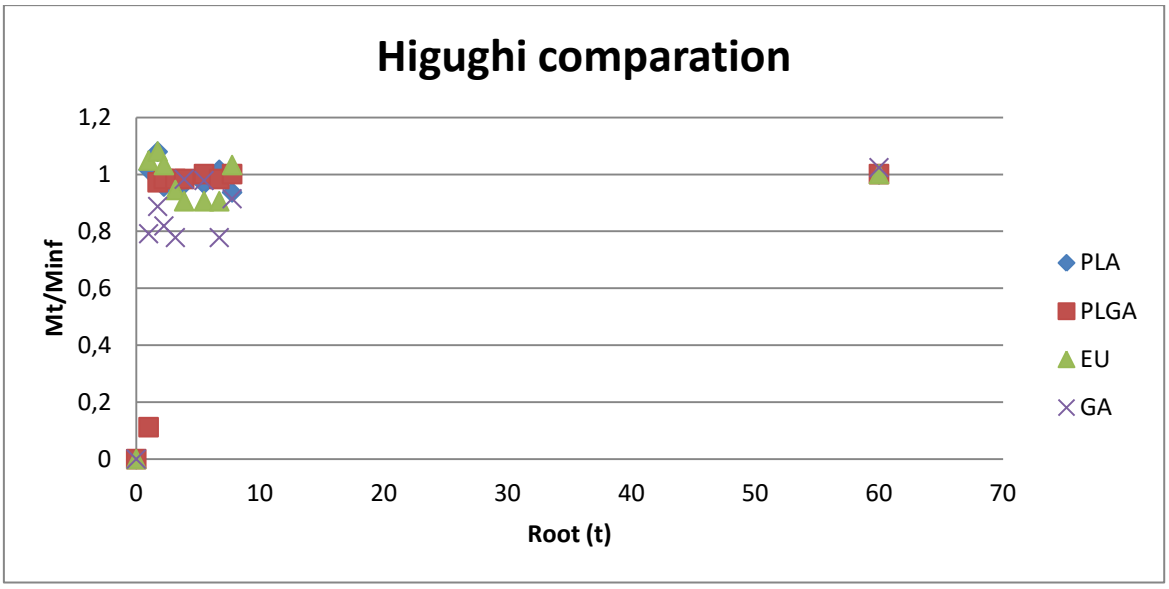


Figure 44: Higuhi comparation for block 1

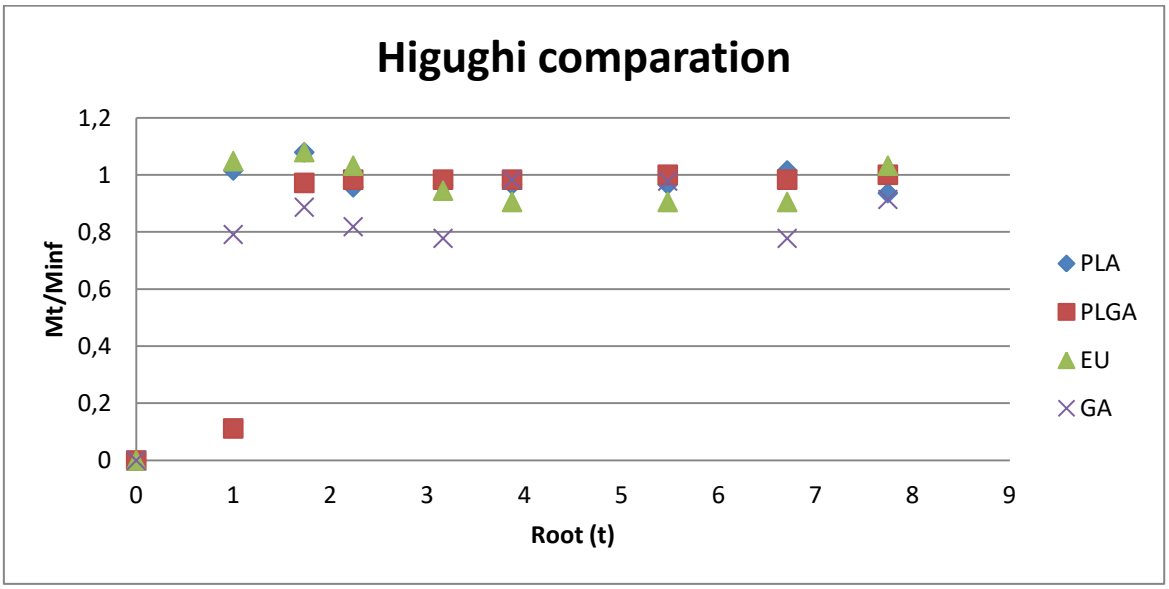


Figure 45: Higuhi comparation (avowing equilibrium point) for block 1

For the Higughi model it is necessary to use his equation for spear explained on the section 4.3:

$$\frac{M_t}{M_{inf}} = K_H * \tau^{1/2}$$

(37)

$$\frac{M_t}{M_{inf}} = \frac{16}{\pi}\left(\frac{D}{r^2}\right)^{1/2} * \tau^{1/2}$$

(38)

Coating material	D (mol/cm^2)	K_H (mol/l*minute)
PLA	0.0499	1.01542
PLGA	-	0.11217
EU	38.92	1.04856
GA	-	0.79162

Table 33: Valour of D and K_H on the block 1

Drug realise of block 2

As it is show on the section *drug delivery*. those are few samples without β-carotene. Thereby we "apply" a factor of 0.0069 for 481 nm and 0.0033 for 454 nm (there are the *b* on each calibration curve's equation) for not have a negative results while those equations are apply. All the calculations are done only for the cotton data. The following table show those results:

Time (min)	ABS	Concentration (mg/ml)	M (mol/l)	Mt/Minf	$\sqrt{\tau}$
0	0	0	0	0	0
1	0.882	3.112E-03	5.797E-06	0.28571	1
3	0.157	1.089E-02	2.029E-05	1.00000	1.73205081
5	0.057	1.867E-03	3.478E-06	0.17143	2.23606798
7	0.057	6.224E-04	1.159E-06	0.05714	2.64575131
10	0.007	6.224E-04	1.159E-06	0.05714	3.16227766
15	0.007	0.000E+00	0.000E+00	0.00000	3.87298335
30	0.007	0.000E+00	0.000E+00	0.00000	5.47722558
45	0.007	0.000E+00	0.000E+00	0.00000	6.70820393
60	0.007	0.000E+00	0.000E+00	0.00000	7.74596669
120	0.257	0.000E+00	0.000E+00	0.00000	10.9544512

Table 34: Results for 481 nm

Time (min)	ABS	Concentration (mg/ml)	M (mol/l)	Mt/Minf	$\sqrt{\tau}$
0	0	0	0	0.00000	0
1	0.307	3.245E-03	6.045E-06	0.29516	1
3	1.032	1.100E-02	2.048E-05	1.00000	1.73205081
5	0.182	1.909E-03	3.556E-06	0.17363	2.23606798
7	0.057	5.730E-04	1.067E-06	0.05211	2.64575131
10	0.057	5.730E-04	1.067E-06	0.05211	3.16227766
15	0.003	0.000E+00	0.000E+00	0.00000	3.87298335
30	0.003	0.000E+00	0.000E+00	0.00000	5.47722558
45	0.003	0.000E+00	0.000E+00	0.00000	6.70820393
60	0.003	0.000E+00	0.000E+00	0.00000	7.74596669
120	0.003	0.000E+00	0.000E+00	0.00000	10.9544512

Table 35: Results for 454 nm

The results from the data of 481 nm and 454 nm are almost equals. for this reason all the graphics since this point are quite similar. Therefore there will be one graphic for each frequency:

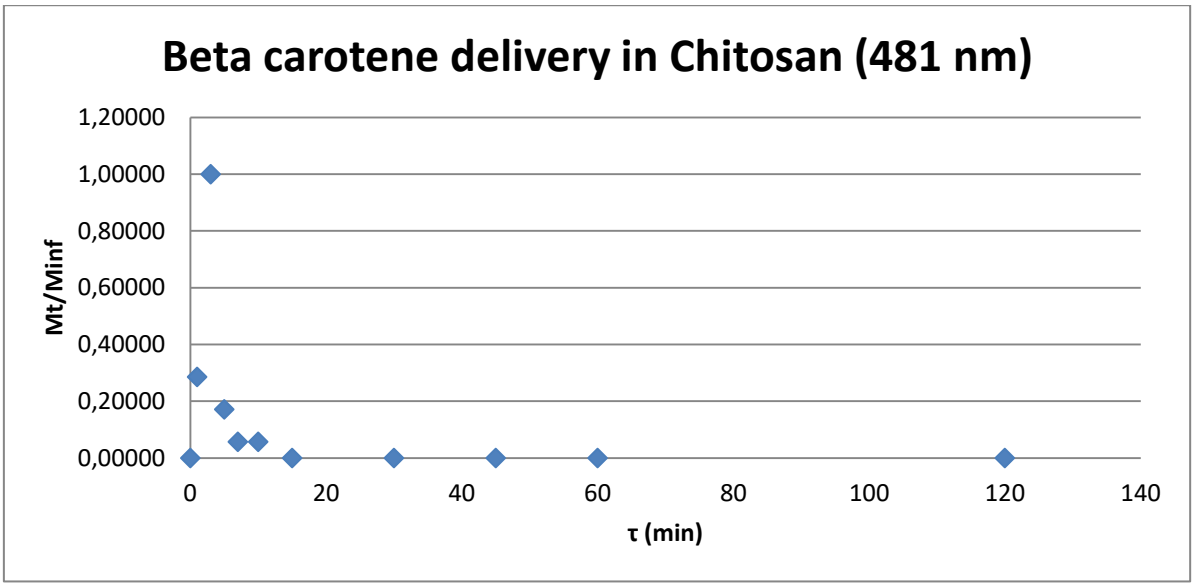


Figure 46

Just in order to see the accumulation of points in the first times of the delivery. is usual recommended to avoid the equilibrium point.

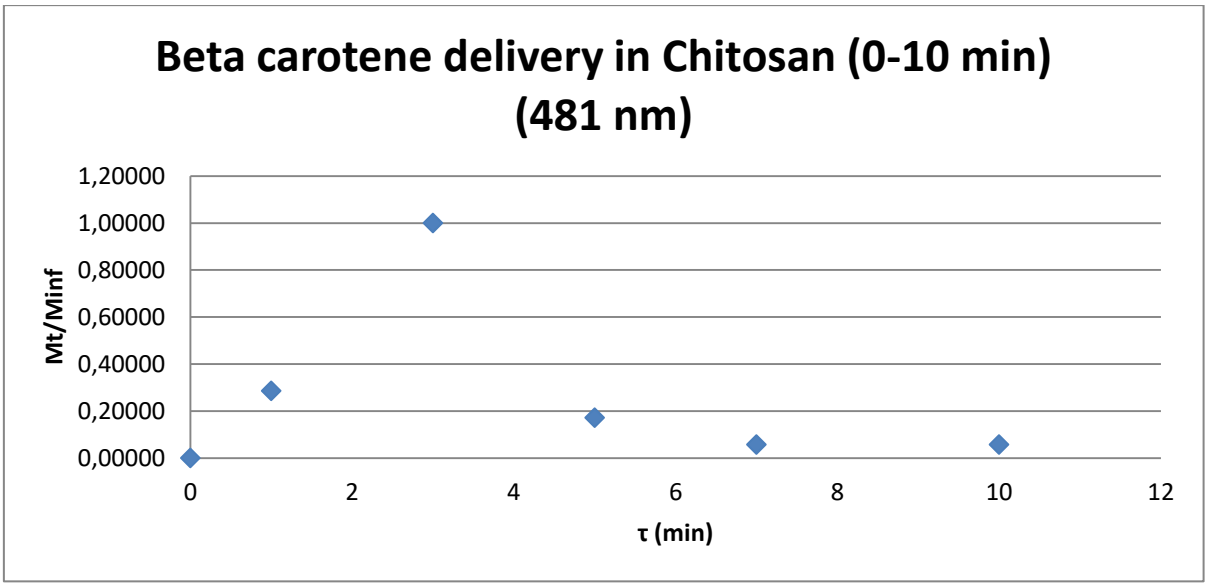


Figure 47

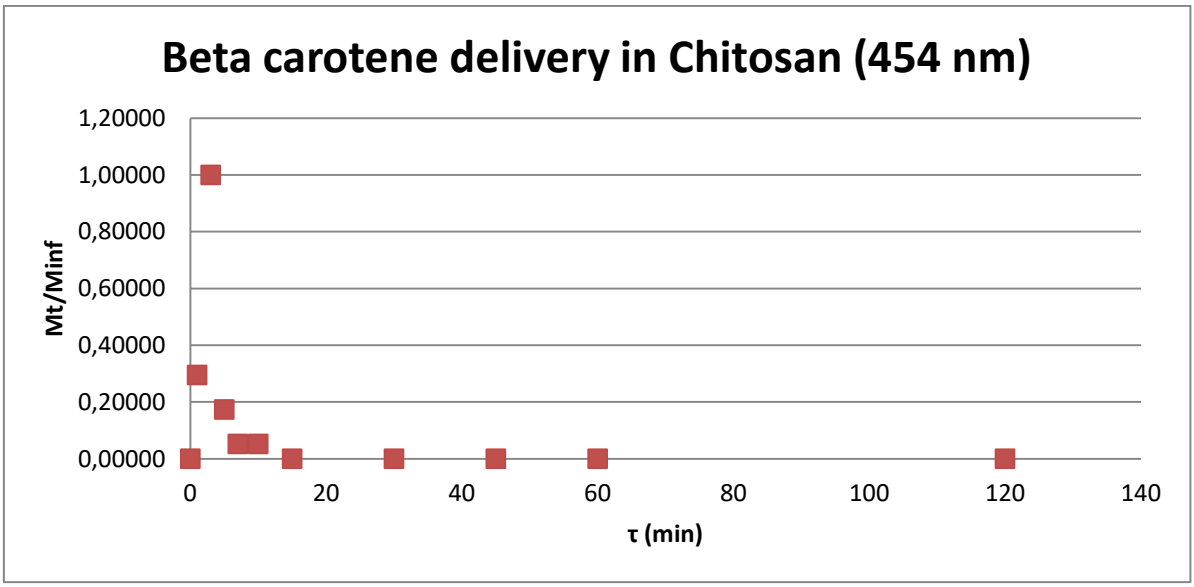


Figure 48

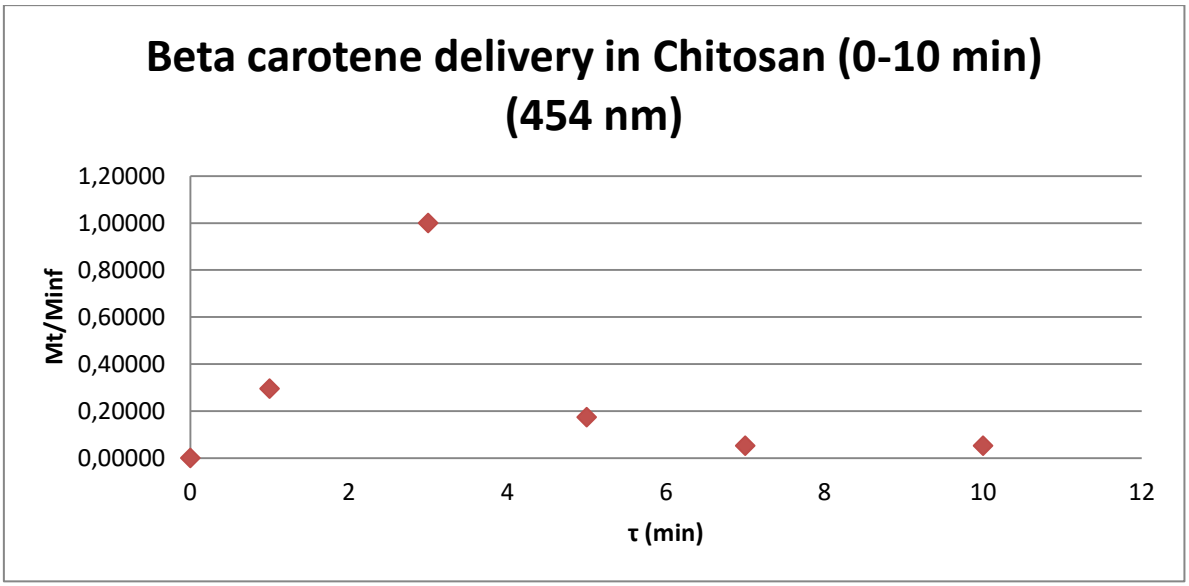


Figure 49

With all the information extracted from the graphics, it can be calculated the valour of *n* and *K* on any point. The table 3 summarize this valour:

$$\log\frac{M_t}{M_{inf}} = \log \mathrm{K} + n\log\tau$$

(39)

$$\log\frac{M_t}{M_{inf}} - n\log\tau = \log \mathrm{K}$$

(40)

$$\left(\log\frac{M_t}{M_{inf}} - n\log\tau\right)_{minute\ 1} = \left(\log\frac{M_t}{M_{inf}} - n\log\tau\right)_{minute\ 3}$$

(41)

Frequencies	*n*	K (mg/ml*minute)
481	2.45	0.0194
454	2.39	0.2137

Table 35: Results of Krossenmeyer-Peppas equation of block 2

The valour of *n* means that the drug realize is independent of time. regardless the geometry. However, we spouse that this valour is *n*=0.5 (limit superior Fickian diffusion) and this let us apply Higughi and know the drug diffusion coefficient. *D* (equation 43).

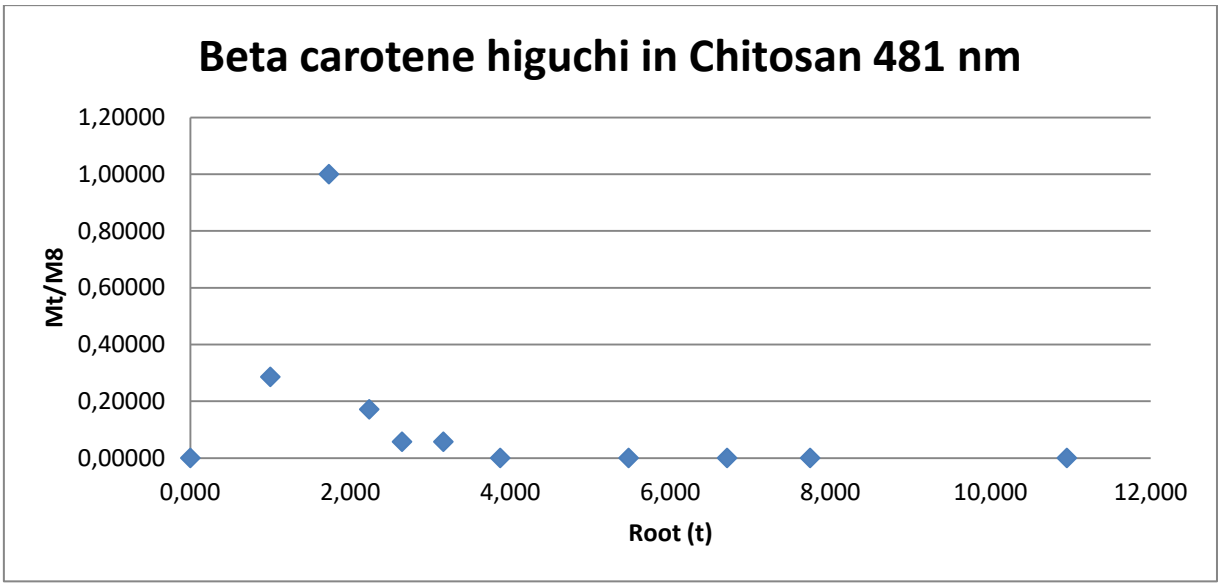


Figure 50

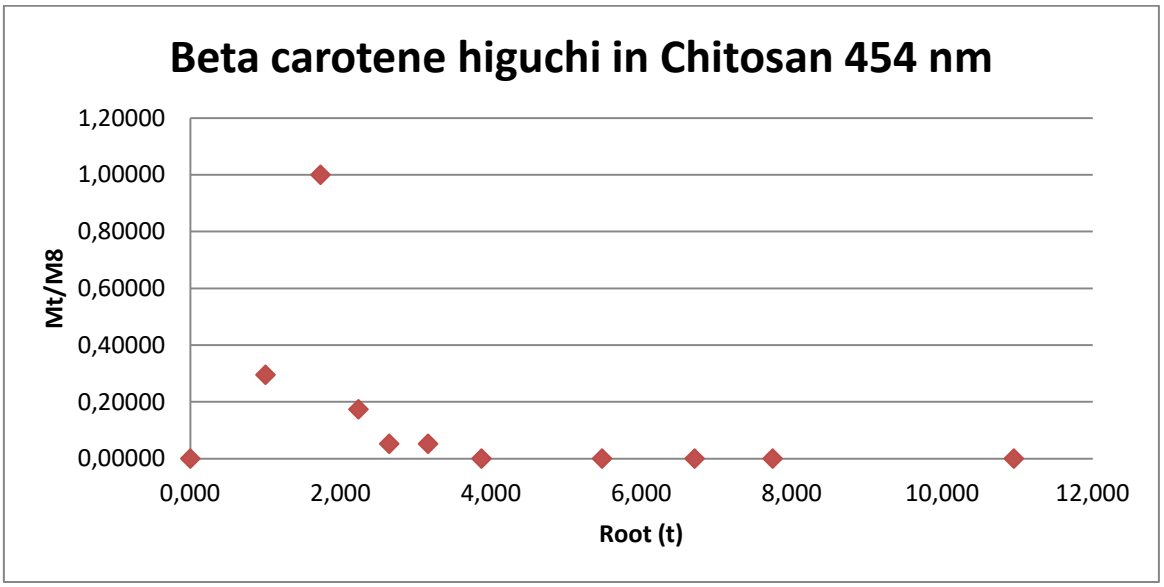


Figure 51

For the Higughi model it is necessary to use his equation for spear explained on the section 4.3:

$$0.28571 = \frac{16}{\pi}\left(\frac{D}{11^2}\right)^{1/2} * 1$$

(42)

$$\left(\frac{0.28571 * \pi * 11}{16}\right)^2 = D$$

(43)

$$D = 0.381\ (mol/cm^2)\ \ K_H = 0.2857\ (mol/l * minute)$$

7.5.3. Conclusions

As can be seen from the graphic (Fig.) of the block 1, except the case of PLGA, every microencapsulated system, shows , from the first moment, a "burst" effect. Basically, all the concentration is capable to deliver to the system (equilibrium) has moved out from the microcapsule.

That fact can be attributed to the lack of stability of the microcapsules formed. Although they seem really stable, the swelling effect of water molecules is capable to affect the whole structure. Therefore, this protocols, should be avoided because they cannot give to the system, a regular a sustained dose.

By the contrary, the polarity of the OH groups in the PLGA copolymer, create more intense interactions between the polymeric chains that constitute the shell part of the microcapsule. Therefore, until the PLGA molecular chains are not hydrolyzed by water, they are not able to deliver the beta-carotene retained inside. Nevertheless, all these first approaches seem to be not good for the purpose planned at the beginning of the work.

It should be necessary to develop different protocols using (as seen from the results) more polar polymer structures (more soluble, more similar to the beta-carotene chemical composition) , that have the possibility to make an stable mixture with other polar chains to "catch" chemically, the beta-carotene molecules, as for example, Chitosan.

As a result of the drug release of the *block* 1, it was changed the coating material to Chitosan. The results of the drug release were promising despite the degradation of the β-carotene. This could be done because of the molecular interaction, besides one of the most common use of β-carotene is on human skin.

8. Conclusions

After running all the test the conclusion is that the coating material used on the *block 1* is better for contain the β-carotene and protect them from the environmental hazards. Nevertheless using the chitosan as a coating material the yield was improve to an industrial valour, proving the viability of this technique into the cosmetic or pharmacologic industry.

If we want to improve the technique, it highly recommends changing the surfactant for change the conditions and do not lose the β-carotene after 10-15 minutes. On the other hand, it is possible to change the Chitosan to a low or high molecular weight and check their behaviour on the drug realise and microencapsulation process.

9. Annex

9.1.Security data sheet 1-Propanol

ThermoFisher SCIENTIFIC

SAFETY DATA SHEET

Creation Date 03-Jun-2010 Revision Date 18-Jan-2018 Revision Number 3

1. Identification

Product Name	1-Propanol
Cat No. :	A414-1; A414-4; A414-20; A414-500; A414RB-50; A414S-4; BP1130-500; XXNPROALCRS200; NC1348124; NC1396483
CAS-No	71-23-8
Synonyms	n-Propanol; n-Propyl alcohol (Certified/Peroxide-Free/Sequencing)
Recommended Use	Laboratory chemicals.
Uses advised against	Not for food, drug, pesticide or biocidal product use

Details of the supplier of the safety data sheet

Company
Fisher Scientific
One Reagent Lane
Fair Lawn, NJ 07410
Tel: (201) 796-7100

Emergency Telephone Number
CHEMTREC®, Inside the USA: 800-424-9300
CHEMTREC®, Outside the USA: 001-703-527-3887

2. Hazard(s) identification

Classification
This chemical is considered hazardous by the 2012 OSHA Hazard Communication Standard (29 CFR 1910.1200)

Flammable liquids	Category 2
Serious Eye Damage/Eye Irritation	Category 1
Specific target organ toxicity (single exposure)	Category 3
Target Organs - Central nervous system (CNS).	

Label Elements

Signal Word
Danger

Hazard Statements
Highly flammable liquid and vapor
Causes serious eye damage
May cause drowsiness or dizziness

Precautionary Statements
Prevention
Wear protective gloves/protective clothing/eye protection/face protection
Avoid breathing dust/fume/gas/mist/vapors/spray
Use only outdoors or in a well-ventilated area
Keep away from heat/sparks/open flames/hot surfaces. - No smoking
Keep container tightly closed
Ground/bond container and receiving equipment
Use explosion-proof electrical/ventilating/lighting/equipment
Use only non-sparking tools
Take precautionary measures against static discharge
Keep cool
Inhalation
IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing
Call a POISON CENTER or doctor/physician if you feel unwell
Skin
IF ON SKIN (or hair): Take off immediately all contaminated clothing. Rinse skin with water/shower
Eyes
IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing
Immediately call a POISON CENTER or doctor/physician
Fire
In case of fire: Use CO2, dry chemical, or foam for extinction
Storage
Store in a well-ventilated place. Keep container tightly closed
Store locked up
Disposal
Dispose of contents/container to an approved waste disposal plant
Hazards not otherwise classified (HNOC)
None identified

3. Composition/Information on Ingredients

Component	CAS-No	Weight %
n-Propyl alcohol	71-23-8	> 99

4. First-aid measures

Eye Contact	Rinse immediately with plenty of water, also under the eyelids, for at least 15 minutes. Immediate medical attention is required.
Skin Contact	Wash off immediately with plenty of water for at least 15 minutes. Get medical attention if symptoms occur.
Inhalation	Move to fresh air. Get medical attention if symptoms occur. If not breathing, give artificial respiration.
Ingestion	Do not induce vomiting. Obtain medical attention.
Most important symptoms and	Breathing difficulties. Causes eye burns. Causes severe eye damage. Inhalation of high

effects	vapor concentrations may cause symptoms like headache, dizziness, tiredness, nausea and vomiting
Notes to Physician	Treat symptomatically

5. Fire-fighting measures

Suitable Extinguishing Media	CO_2, dry chemical, dry sand, alcohol-resistant foam. Cool closed containers exposed to fire with water spray.
Unsuitable Extinguishing Media	Water may be ineffective
Flash Point	15 °C / 59 °F
Method -	No information available
Autoignition Temperature	405 °C / 761 °F
Explosion Limits	
Upper	13.7 vol %
Lower	2.2 vol %
Sensitivity to Mechanical Impact	No information available
Sensitivity to Static Discharge	No information available

Specific Hazards Arising from the Chemical
Flammable. Vapors may form explosive mixtures with air. Vapors may travel to source of ignition and flash back. Containers may explode when heated. Thermal decomposition can lead to release of irritating gases and vapors. Keep product and empty container away from heat and sources of ignition.

Hazardous Combustion Products
Carbon monoxide (CO) Carbon dioxide (CO_2)
Protective Equipment and Precautions for Firefighters
As in any fire, wear self-contained breathing apparatus pressure-demand, MSHA/NIOSH (approved or equivalent) and full protective gear.

NFPA

Health	Flammability	Instability	Physical hazards
1	3	0	N/A

6. Accidental release measures

Personal Precautions	Use personal protective equipment. Remove all sources of ignition. Take precautionary measures against static discharges. Avoid contact with skin, eyes and clothing.
Environmental Precautions	Avoid release to the environment. See Section 12 for additional ecological information.
Methods for Containment and Clean Up	Remove all sources of ignition. Soak up with inert absorbent material. Keep in suitable, closed containers for disposal. Take precautionary measures against static discharges. Use spark-proof tools and explosion-proof equipment.

7. Handling and storage

Handling	Wear personal protective equipment. Do not get in eyes, on skin, or on clothing. Avoid ingestion and inhalation. Keep away from open flames, hot surfaces and sources of ignition. Use only non-sparking tools. Use explosion-proof equipment. Take precautionary measures against static discharges. To avoid ignition of vapors by static electricity discharge, all metal parts of the equipment must be grounded.
Storage	Keep containers tightly closed in a dry, cool and well-ventilated place. Keep away from heat and sources of ignition. Flammables area.

8. Exposure controls / personal protection

Exposure Guidelines

Component	ACGIH TLV	OSHA PEL	NIOSH IDLH	Mexico OEL (TWA)
n-Propyl alcohol	TWA: 100 ppm	(Vacated) TWA: 200 ppm (Vacated) TWA: 500 mg/m³ (Vacated) STEL: 250 ppm (Vacated) STEL: 625 mg/m³ TWA: 200 ppm TWA: 500 mg/m³	IDLH: 800 ppm TWA: 200 ppm TWA: 500 mg/m³ STEL: 250 ppm STEL: 625 mg/m³	TWA: 200 ppm TWA: 500 mg/m³ STEL: 250 ppm STEL: 625 mg/m³

Legend

ACGIH - American Conference of Governmental Industrial Hygienists
OSHA - Occupational Safety and Health Administration
NIOSH IDLH: The National Institute for Occupational Safety and Health Immediately Dangerous to Life or Health

Engineering Measures — Ensure adequate ventilation, especially in confined areas. Use explosion-proof electrical/ventilating/lighting/equipment. Ensure that eyewash stations and safety showers are close to the workstation location.

Personal Protective Equipment

Eye/face Protection — Wear appropriate protective eyeglasses or chemical safety goggles as described by OSHA's eye and face protection regulations in 29 CFR 1910.133 or European Standard EN166.

Skin and body protection — Wear appropriate protective gloves and clothing to prevent skin exposure.

Respiratory Protection — Follow the OSHA respirator regulations found in 29 CFR 1910.134 or European Standard EN 149. Use a NIOSH/MSHA or European Standard EN 149 approved respirator if exposure limits are exceeded or if irritation or other symptoms are experienced.

Hygiene Measures — Handle in accordance with good industrial hygiene and safety practice.

9. Physical and chemical properties

Physical State	Liquid
Appearance	Colorless
Odor	Alcohol-like
Odor Threshold	No information available
pH	7 20% aq. solution
Melting Point/Range	-127 °C / -196.6 °F
Boiling Point/Range	97 °C / 206.6 °F @ 760 mmHg
Flash Point	15 °C / 59 °F
Evaporation Rate	No information available
Flammability (solid,gas)	Not applicable
Flammability or explosive limits	
Upper	13.7 vol %
Lower	2.2 vol %
Vapor Pressure	25 mbar @ 20 °C
Vapor Density	2.07
Specific Gravity	0.800
Solubility	Miscible with water
Partition coefficient; n-octanol/water	No data available
Autoignition Temperature	405 °C / 761 °F
Decomposition Temperature	No information available
Viscosity	2.2 mPa.s at 20 °C
Molecular Formula	C3 H8 O
Molecular Weight	60.1

10. Stability and reactivity

Reactive Hazard	None known, based on information available
Stability	Stable under normal conditions.
Conditions to Avoid	Incompatible products. Excess heat. Keep away from open flames, hot surfaces and sources of ignition.
Incompatible Materials	Strong oxidizing agents, Strong acids
Hazardous Decomposition Products	Carbon monoxide (CO), Carbon dioxide (CO_2)
Hazardous Polymerization	Hazardous polymerization does not occur.
Hazardous Reactions	None under normal processing.

11. Toxicological information

Acute Toxicity

Product Information
Component Information

Component	LD50 Oral	LD50 Dermal	LC50 Inhalation
n-Propyl alcohol	LD50 = 1870 mg/kg (Rat)	LD50 = 4049 mg/kg (Rabbit)	LC50 > 13548 ppm (Rat) 4 h

Toxicologically Synergistic Products: No information available

Delayed and immediate effects as well as chronic effects from short and long-term exposure

Irritation	Severe eye irritant
Sensitization	No information available
Carcinogenicity	The table below indicates whether each agency has listed any ingredient as a carcinogen.

Component	CAS-No	IARC	NTP	ACGIH	OSHA	Mexico
n-Propyl alcohol	71-23-8	Not listed	Not listed	Not listed	Not listed	Not listed

Mutagenic Effects	No information available
Reproductive Effects	No information available.
Developmental Effects	No information available.
Teratogenicity	No information available.
STOT - single exposure	Central nervous system (CNS)
STOT - repeated exposure	None known
Aspiration hazard	No information available
Symptoms / effects,both acute and delayed	Inhalation of high vapor concentrations may cause symptoms like headache, dizziness, tiredness, nausea and vomiting
Endocrine Disruptor Information	No information available
Other Adverse Effects	The toxicological properties have not been fully investigated.

12. Ecological information

Ecotoxicity

Do not empty into drains. .

Component	Freshwater Algae	Freshwater Fish	Microtox	Water Flea
n-Propyl alcohol	Not listed	Pimephales promelas: LC50=4480 mg/L 96h	EC50 = 17700 mg/L 5 min EC50 = 45000 mg/L 5 h EC50 = 8686 mg/L 15 min EC50 = 980 mg/L 12 h	EC50: 3339 - 3977 mg/L, 48h Static (Daphnia magna) EC50: = 3642 mg/L, 48h (Daphnia magna)

Persistence and Degradability: Persistence is unlikely

Bioaccumulation/ Accumulation: No information available.

Mobility: . Will likely be mobile in the environment due to its water solubility.

Component	log Pow
n-Propyl alcohol	0.25 - 0.34

13. Disposal considerations

Waste Disposal Methods: Chemical waste generators must determine whether a discarded chemical is classified as a hazardous waste. Chemical waste generators must also consult local, regional, and national hazardous waste regulations to ensure complete and accurate classification.

14. Transport information

DOT
- UN-No: UN1274
- Proper Shipping Name: N-PROPANOL
- Hazard Class: 3
- Packing Group: II

TDG
- UN-No: UN1274
- Proper Shipping Name: n-Propanol
- Hazard Class: 3
- Packing Group: II

IATA
- UN-No: UN1274
- Proper Shipping Name: n-PROPANOL
- Hazard Class: 3
- Packing Group: II

IMDG/IMO
- UN-No: UN1274
- Proper Shipping Name: N-PROPANOL
- Hazard Class: 3
- Packing Group: II

15. Regulatory information

International Inventories

Component	TSCA	DSL	NDSL	EINECS	ELINCS	NLP	PICCS	ENCS	AICS	IECSC	KECL
n-Propyl alcohol	X	X	-	200-746-9	-		X	X	X	X	X

Legend:
X - Listed
E - Indicates a substance that is the subject of a Section 5(e) Consent order under TSCA.
F - Indicates a substance that is the subject of a Section 5(f) Rule under TSCA.
N - Indicates a polymeric substance containing no free-radical initiator in its inventory name but is considered to cover the designated polymer made with any free-radical initiator regardless of the amount used.
P - Indicates a commenced PMN substance
R - Indicates a substance that is the subject of a Section 6 risk management rule under TSCA.
S - Indicates a substance that is identified in a proposed or final Significant New Use Rule
T - Indicates a substance that is the subject of a Section 4 test rule under TSCA.
XU - Indicates a substance exempt from reporting under the Inventory Update Rule, i.e. Partial Updating of the TSCA Inventory Data Base Production and Site Reports (40 CFR 710(B).
Y1 - Indicates an exempt polymer that has a number-average molecular weight of 1,000 or greater.

Y2 - Indicates an exempt polymer that is a polyester and is made only from reactants included in a specified list of low concern reactants that comprises one of the eligibility criteria for the exemption rule.

U.S. Federal Regulations

TSCA 12(b) Not applicable

SARA 313 Not applicable

SARA 311/312 Hazard Categories See section 2 for more information

CWA (Clean Water Act) Not applicable

Clean Air Act Not applicable

OSHA Occupational Safety and Health Administration
Not applicable

CERCLA Not applicable

California Proposition 65 This product does not contain any Proposition 65 chemicals

U.S. State Right-to-Know Regulations

Component	Massachusetts	New Jersey	Pennsylvania	Illinois	Rhode Island
n-Propyl alcohol	X	X	X	-	X

U.S. Department of Transportation

Reportable Quantity (RQ): N
DOT Marine Pollutant N
DOT Severe Marine Pollutant N

U.S. Department of Homeland Security
This product does not contain any DHS chemicals.

Other International Regulations

Mexico - Grade Serious risk, Grade 3

16. Other information

Prepared By Regulatory Affairs
Thermo Fisher Scientific
Email: EMSDS.RA@thermofisher.com

Creation Date 03-Jun-2010
Revision Date 18-Jan-2018
Print Date 18-Jan-2018
Revision Summary This document has been updated to comply with the US OSHA HazCom 2012 Standard replacing the current legislation under 29 CFR 1910.1200 to align with the Globally Harmonized System of Classification and Labeling of Chemicals (GHS).

Disclaimer
The information provided in this Safety Data Sheet is correct to the best of our knowledge, information and belief at the date of its publication. The information given is designed only as a guidance for safe handling, use, processing, storage, transportation, disposal and release and is not to be considered a warranty or quality specification. The information relates only to the specific material designated and may not be valid for such material used in combination with any other materials or in any process, unless specified in the text

End of SDS

9.2.Security data sheet Chitosan

Chitosan CAS No 9012-76-4	MATERIAL SAFETY DATA SHEET SDS/MSDS

SECTION 1: Identification of the substance/mixture and of the company/undertaking

1.1 Product identifiers

Product name : Chitosan

CAS-No. : 9012-76-4

1.2 Relevant identified uses of the substance or mixture and uses advised against

Identified uses : Laboratory chemicals, Industrial & for professional use only.

1.3 Details of the supplier of the safety data sheet

Company : Central Drug House (P) Ltd
7/28 Vardaan House
New Delhi-10002
INDIA

Telephone : +91 11 49404040
Email : care@cdhfinechemical.com

1.4 Emergency telephone number

Emergency Phone # : +91 11 49404040 (9:00am - 6:00 pm) [Office hours]

SECTION 2: Hazards identification

2.1 Classification of the substance or mixture

Not a hazardous substance or mixture according to Regulation (EC) No. 1272/2008.

2.2 Label elements

Not a hazardous substance or mixture according to Regulation (EC) No. 1272/2008.

2.3 Other hazards

This substance/mixture contains no components considered to be either persistent, bioaccumulative and toxic (PBT), or very persistent and very bioaccumulative (vPvB) at levels of 0.1% or higher.

SECTION 3: Composition/information on ingredients

3.1 Substances

Synonyms : Poly(D-glucosamine)
Deacetylated chitin

CAS-No. : 9012-76-4

No components need to be disclosed according to the applicable regulations.

SECTION 4: First aid measures

4.1 Description of first aid measures

General advice
Consult a physician. Show this safety data sheet to the doctor in attendance.

If inhaled
If breathed in, move person into fresh air. If not breathing, give artificial respiration. Consult a physician.

In case of skin contact
Wash off with soap and plenty of water. Consult a physician.

In case of eye contact
Flush eyes with water as a precaution.

If swallowed
Never give anything by mouth to an unconscious person. Rinse mouth with water. Consult a physician.

4.2 Most important symptoms and effects, both acute and delayed
The most important known symptoms and effects are described in the labelling (see section 2.2) and/or in section 11

4.3 Indication of any immediate medical attention and special treatment needed
No data available

SECTION 5: Firefighting measures

5.1 Extinguishing media

Suitable extinguishing media
Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide.

5.2 Special hazards arising from the substance or mixture
Carbon oxides, Nitrogen oxides (NOx)

5.3 Advice for firefighters
Wear self-contained breathing apparatus for firefighting if necessary.

5.4 Further information
No data available

SECTION 6: Accidental release measures

6.1 Personal precautions, protective equipment and emergency procedures
Avoid dust formation. Avoid breathing vapours, mist or gas. Ensure adequate ventilation.
For personal protection see section 8.

6.2 Environmental precautions
Prevent further leakage or spillage if safe to do so. Do not let product enter drains. Discharge into the environment must be avoided.

6.3 Methods and materials for containment and cleaning up
Pick up and arrange disposal without creating dust. Sweep up and shovel. Keep in suitable, closed containers for disposal.

6.4 Reference to other sections
For disposal see section 13.

SECTION 7: Handling and storage

7.1 Precautions for safe handling
Provide appropriate exhaust ventilation at places where dust is formed.
For precautions see section 2.2.

7.2 Conditions for safe storage, including any incompatibilities
Store in cool place. Keep container tightly closed in a dry and well-ventilated place.

Storage class (TRGS 510): Combustible Solids

7.3 Specific end use(s)
Apart from the uses mentioned in section 1.2 no other specific uses are stipulated

SECTION 8: Exposure controls/personal protection

8.1 Control parameters

8.2 Exposure controls

Appropriate engineering controls
Handle in accordance with good industrial hygiene and safety practice. Wash hands before breaks and at the end of workday.

Personal protective equipment

Eye/face protection
Use equipment for eye protection tested and approved under appropriate government standards such as NIOSH (US) or EN 166(EU).

Skin protection
Handle with gloves. Gloves must be inspected prior to use. Use proper glove removal technique (without touching glove's outer surface) to avoid skin contact with this product. Dispose of contaminated gloves after use in accordance with applicable laws and good laboratory practices. Wash and dry hands.

Body Protection
Choose body protection in relation to its type, to the concentration and amount of dangerous substances, and to the specific work-place., The type of protective equipment must be selected according to the concentration and amount of the dangerous substance at the specific workplace.

Respiratory protection
Respiratory protection is not required. Where protection from nuisance le (EN 143) dust masks. Use respirators and components tested and approved under appropriate government standards such as NIOSH (US) or CEN (EU).

Control of environmental exposure
Prevent further leakage or spillage if safe to do so. Do not let product enter drains. Discharge into the environment must be avoided.

SECTION 9: Physical and chemical properties

9.1 Information on basic physical and chemical properties

a)	Appearance	Form: powder Colour: beige
b)	Odour	No data available
c)	Odour Threshold	No data available
d)	pH	No data available
e)	Melting point/freezing point	No data available
f)	Initial boiling point and boiling range	No data available
g)	Flash point	No data available
h)	Evaporation rate	No data available
i)	Flammability (solid, gas)	No data available
j)	Upper/lower flammability or explosive limits	No data available
k)	Vapour pressure	No data available
l)	Vapour density	No data available

m)	Relative density	No data available
n)	Water solubility	No data available
o)	Partition coefficient: n-octanol/water	No data available
p)	Auto-ignition temperature	No data available
q)	Decomposition temperature	No data available
r)	Viscosity	No data available
s)	Explosive properties	No data available
t)	Oxidizing properties	No data available

9.2 Other safety information
No data available

SECTION 10: Stability and reactivity

10.1 Reactivity
No data available

10.2 Chemical stability
Stable under recommended storage conditions.

10.3 Possibility of hazardous reactions
No data available

10.4 Conditions to avoid
No data available

10.5 Incompatible materials
Strong oxidizing agents

10.6 Hazardous decomposition products
Hazardous decomposition products formed under fire conditions. - Carbon oxides, Nitrogen oxides (NOx)
Other decomposition products - No data available
In the event of fire: see section 5

SECTION 11: Toxicological information

11.1 Information on toxicological effects

Acute toxicity
LD50 Oral - Rat - > 10,000 mg/kg(Chitosan)

Skin corrosion/irritation
No data available(Chitosan)

Serious eye damage/eye irritation
No data available(Chitosan)

Respiratory or skin sensitisation
No data available(Chitosan)

Germ cell mutagenicity

No data available(Chitosan)

Carcinogenicity

IARC: No component of this product present at levels greater than or equal to 0.1% is identified as probable, possible or confirmed human carcinogen by IARC.

Reproductive toxicity

No data available(Chitosan)

Specific target organ toxicity - single exposure
No data available(Chitosan)

Specific target organ toxicity - repeated exposure
No data available

Aspiration hazard
No data available(Chitosan)

Additional Information
RTECS: Not available

To the best of our knowledge, the chemical, physical, and toxicological properties have not been thoroughly investigated.(Chitosan)

SECTION 12: Ecological information

12.1 Toxicity

Toxicity to fish	LC50 - Oncorhynchus mykiss (rainbow trout) - 1.73 mg/l - 96 h(Chitosan)
Toxicity to daphnia and other aquatic invertebrates	EC50 - Daphnia pulex (Water flea) - 13.69 mg/l - 48 h(Chitosan)

12.2 Persistence and degradability
No data available

12.3 Bioaccumulative potential
No data available

12.4 Mobility in soil
No data available(Chitosan)

12.5 Results of PBT and vPvB assessment
This substance/mixture contains no components considered to be either persistent, bioaccumulative and toxic (PBT), or very persistent and very bioaccumulative (vPvB) at levels of 0.1% or higher.

12.6 Other adverse effects
Toxic to aquatic life.

SECTION 13: Disposal considerations

13.1 Waste treatment methods

Product
Offer surplus and non-recyclable solutions to a licensed disposal company. Dissolve or mix the material with a combustible solvent and burn in a chem scrubber.

Contaminated packaging
Dispose of as unused product.

SECTION 14: Transport information

14.1 UN number

ADR/RID: - IMDG: - IATA: -

14.2 UN proper shipping name

ADR/RID: Not dangerous goods
IMDG: Not dangerous goods
IATA: Not dangerous goods

14.3 Transport hazard class(es)

ADR/RID: - IMDG: - IATA: -

14.4 Packaging group

ADR/RID: - IMDG: - IATA: -

14.5 Environmental hazards

ADR/RID: no IMDG Marine pollutant: no IATA: no

14.6 Special precautions for user

No data available

SECTION 15: Regulatory information

15.1 Safety, health and environmental regulations/legislation specific for the substance or mixture

This safety datasheet complies with the requirements of Regulation (EC) No. 1907/2006.

15.2 Chemical safety assessment

For this product a chemical safety assessment was not carried out

SECTION 16: Other information

Further information

The above information is believed to be correct but does not purport to be all inclusive and shall be used only as a guide. The information in this document is based on the present state of our knowledge and is applicable to the product with regard to appropriate safety precautions. It does not represent any guarantee of the properties of the product. Central Drug House (P) Ltd and its Affiliates shall not be held liable for any damage resulting from handling or from contact with the above product. See www.cdhfinechemical.com for additional terms and conditions of sale.

9.3.Security data sheet Acetone

LabChem
performance through chemistry

Acetone

Safety Data Sheet

according to Federal Register / Vol. 77, No. 58 / Monday, March 26, 2012 / Rules and Regulations

Date of issue: 11/12/1998 Revision date: 04/24/2018 Supersedes: 04/24/2018 Version: 1.3

SECTION 1: Identification

1.1. Identification

Product form	:	Substance
Substance name	:	Acetone
Chemical name	:	2-Propanone
CAS-No.	:	67-64-1
Product code	:	LC10420, LC10425
Formula	:	C3H6O
Synonyms	:	2-propanone / beta-ketopropane / dimethyl formaldehyde / dimethyl ketone / dimethylketal / DMK (=dimethyl ketone) / keto propane / methyl ketone / pyroacetic acid / pyroacetic ether / pyroacetic spirit

1.2. Recommended use and restrictions on use

Use of the substance/mixture	:	Solvent Cleaning product Chemical raw material
Recommended use	:	Laboratory chemicals
Restrictions on use	:	Not for food, drug or household use

1.3. Supplier

LabChem, Inc.

Jackson's Pointe Commerce Park Building 1000, 1010 Jackson's Pointe Court

Zelienople, PA 16063 - USA

T 412-826-5230 - F 724-473-0647

1.4. Emergency telephone number

Emergency number : CHEMTREC: 1-800-424-9300 or +1-703-741-5970

SECTION 2: Hazard(s) identification

2.1. Classification of the substance or mixture

GHS-US classification

Flammable liquids Category 2	H225	Highly flammable liquid and vapour
Serious eye damage/eye irritation Category 2A	H319	Causes serious eye irritation
Specific target organ toxicity (single exposure) Category 3	H336	May cause drowsiness or dizziness

Full text of H statements : see section 16

2.2. GHS Label elements, including precautionary statements

GHS US labeling

Hazard pictograms (GHS US) :

GHS02 GHS07

Signal word (GHS US) : Danger

Hazard statements (GHS US) :
H225 - Highly flammable liquid and vapour
H319 - Causes serious eye irritation
H336 - May cause drowsiness or dizziness

Precautionary statements (GHS US) :
P210 - Keep away from heat, hot surfaces, open flames, sparks. - No smoking.
P233 - Keep container tightly closed.
P240 - Ground/bond container and receiving equipment.
P241 - Use explosion-proof electrical, lighting, ventilating equipment
P242 - Use only non-sparking tools.
P243 - Take precautionary measures against static discharge.
P261 - Avoid breathing mist, spray, vapors.

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P264 - Wash exposed skin thoroughly after handling.
P271 - Use only outdoors or in a well-ventilated area.
P280 - Wear eye protection, face protection, protective clothing, protective gloves.
P303+P361+P353 - IF ON SKIN (or hair): Remove/Take off immediately all contaminated clothing. Rinse skin with water/shower.
P304+P340 - IF INHALED: Remove person to fresh air and keep comfortable for breathing.
P305+P351+P338 - If in eyes: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing
P312 - Call a POISON CENTER or doctor/physician if you feel unwell.
P337+P313 - If eye irritation persists: Get medical advice/attention.
P370+P378 - In case of fire: Use dry chemical powder, alcohol-resistant foam, carbon dioxide (CO2) to extinguish
P403+P233 - Store in a well-ventilated place. Keep container tightly closed.
P405 - Store locked up.
P501 - Dispose of contents/container to comply with local, state and federal regulations
P235 - Keep cool.

2.3. Other hazards which do not result in classification

Other hazards not contributing to the classification : None.

2.4. Unknown acute toxicity (GHS US)

Not applicable

SECTION 3: Composition/Information on ingredients

3.1. Substances

Substance type : Mono-constituent

Name	Product identifier	%	GHS-US classification
Acetone (Main constituent)	(CAS-No.) 67-64-1	100	Flam. Liq. 2, H225 Eye Irrit. 2A, H319 STOT SE 3, H336

Full text of hazard classes and H-statements : see section 16

3.2. Mixtures

Not applicable

SECTION 4: First-aid measures

4.1. Description of first aid measures

First-aid measures general : Check the vital functions. Unconscious: maintain adequate airway and respiration. Respiratory arrest: artificial respiration or oxygen. Cardiac arrest: perform resuscitation. Victim conscious with labored breathing: half-seated. Victim in shock: on his back with legs slightly raised. Vomiting: prevent asphyxia/aspiration pneumonia. Prevent cooling by covering the victim (no warming up). Keep watching the victim. Give psychological aid. Keep the victim calm, avoid physical strain. Depending on the victim's condition: doctor/hospital.

First-aid measures after inhalation : Remove the victim into fresh air. Respiratory problems: consult a doctor/medical service.

First-aid measures after skin contact : Wash immediately with lots of water. Soap may be used. Do not apply (chemical) neutralizing agents. Remove clothing before washing. Take victim to a doctor if irritation persists.

First-aid measures after eye contact : Rinse immediately with plenty of water. Remove contact lenses, if present and easy to do. Continue rinsing. Do not apply neutralizing agents. Take victim to an ophthalmologist if irritation persists.

First-aid measures after ingestion : Rinse mouth with water. Immediately after ingestion: give lots of water to drink. Do not give milk/oil to drink. Do not induce vomiting. Give activated charcoal. Call Poison Information Centre (www.big.be/antigif.htm). Consult a doctor/medical service if you feel unwell. Ingestion of large quantities: immediately to hospital. Doctor: gastric lavage.

4.2. Most important symptoms and effects (acute and delayed)

Symptoms/effects : Not expected to present a significant hazard under anticipated conditions of normal use.

Symptoms/effects after inhalation : EXPOSURE TO HIGH CONCENTRATIONS: Feeling of weakness. Irritation of the respiratory tract. Nausea. Vomiting. Headache. Central nervous system depression. Dizziness. Narcosis. Excited/restless. Drunkenness. Disturbed motor response. Respiratory difficulties. Disturbances of consciousness.

Symptoms/effects after skin contact : ON CONTINUOUS EXPOSURE/CONTACT: Dry skin. Cracking of the skin.

Symptoms/effects after eye contact : Irritation of the eye tissue.

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Symptoms/effects after ingestion	:	Dry/sore throat. Risk of aspiration pneumonia. Symptoms similar to those listed under inhalation. AFTER ABSORPTION OF LARGE QUANTITIES: Irritation of the gastric/intestinal mucosa. Change in the blood composition. Change in urine output. Renal disease. Enlargement/disease of the liver.
Symptoms/effects upon intravenous administration	:	Not available.
Chronic symptoms	:	ON CONTINUOUS/REPEATED EXPOSURE/CONTACT: Red skin. Skin rash/inflammation. Dry/sore throat. Headache. Nausea. Feeling of weakness. Loss of weight. Possible inflammation of the respiratory tract.

4.3. Immediate medical attention and special treatment, if necessary

Obtain medical assistance.

SECTION 5: Fire-fighting measures

5.1. Suitable (and unsuitable) extinguishing media

Suitable extinguishing media	:	Quick-acting ABC powder extinguisher. Quick-acting BC powder extinguisher. Quick-acting class B foam extinguisher. Quick-acting CO2 extinguisher. Class B foam (alcohol-resistant). Water spray if puddle cannot expand.
Unsuitable extinguishing media	:	Water (quick-acting extinguisher, reel); risk of puddle expansion. Water; risk of puddle expansion.

5.2. Specific hazards arising from the chemical

Fire hazard	:	DIRECT FIRE HAZARD. Highly flammable liquid and vapour. Gas/vapor flammable with air within explosion limits. INDIRECT FIRE HAZARD. May be ignited by sparks. Gas/vapor spreads at floor level: ignition hazard. Reactions involving a fire hazard: see "Reactivity Hazard".
Explosion hazard	:	DIRECT EXPLOSION HAZARD. Gas/vapour explosive with air within explosion limits. INDIRECT EXPLOSION HAZARD. Heat may cause pressure rise in tanks/drums: explosion risk. may be ignited by sparks. Reactions with explosion hazards: see "Reactivity Hazard".
Reactivity	:	Violent to explosive reaction with many compounds. Prolonged storage: on exposure to light: release of harmful gases/vapours.

5.3. Special protective equipment and precautions for fire-fighters

Firefighting instructions	:	Cool tanks/drums with water spray/remove them into safety. Physical explosion risk: extinguish/cool from behind cover. Do not move the load if exposed to heat. After cooling: persistant risk of physical explosion.
Protection during firefighting	:	Heat/fire exposure: compressed air/oxygen apparatus.

SECTION 6: Accidental release measures

6.1. Personal precautions, protective equipment and emergency procedures

6.1.1. For non-emergency personnel

Protective equipment	:	Gloves. Protective goggles. Protective clothing. Large spills/in enclosed spaces: compressed air apparatus.
Emergency procedures	:	Keep upwind. Mark the danger area. Consider evacuation. Seal off low-lying areas. Close doors and windows of adjacent premises. Stop engines and no smoking. No naked flames or sparks. Spark- and explosion-proof appliances and lighting equipment. Keep containers closed. Wash contaminated clothes.

6.1.2. For emergency responders

Protective equipment	:	Equip cleanup crew with proper protection.
Emergency procedures	:	Ventilate area.

6.2. Environmental precautions

Prevent spreading in sewers.

6.3. Methods and material for containment and cleaning up

For containment	:	Contain released substance, pump into suitable containers. Plug the leak, cut off the supply. Dam up the liquid spill. Try to reduce evaporation. Measure the concentration of the explosive gas-air mixture. Dilute/disperse combustible gas/vapour with water curtain. Provide equipment/receptacles with earthing. Do not use compressed air for pumping over spills.
Methods for cleaning up	:	Take up liquid spill into inert absorbent material, e.g.: sand, earth, vermiculite. Scoop absorbed substance into closing containers. Spill must not return in its original container. Carefully collect the spill/leftovers. Damaged/cooled tanks must be emptied. Do not use compressed air for pumping over spills. Clean contaminated surfaces with an excess of water. Take collected spill to manufacturer/competent authority. Wash clothing and equipment after handling.

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6.4. Reference to other sections

See Heading 8. Exposure controls and personal protection.

SECTION 7: Handling and storage

7.1. Precautions for safe handling

Precautions for safe handling : Use spark-/explosionproof appliances and lighting system. Take precautions against electrostatic charges. Keep away from naked flames/heat. Keep away from ignition sources/sparks. Measure the concentration in the air regularly. Work under local exhaust/ventilation. Comply with the legal requirements. Remove contaminated clothing immediately. Clean contaminated clothing. Handle uncleaned empty containers as full ones. Thoroughly clean/dry the installation before use. Do not discharge the waste into the drain. Do not use compressed air for pumping over. Keep container tightly closed.

Hygiene measures : Do not eat, drink or smoke when using this product. Wash contaminated clothing before reuse. Wash hands and other exposed areas with mild soap and water before eating, drinking or smoking and when leaving work.

7.2. Conditions for safe storage, including any incompatibilities

Storage conditions : Keep only in the original container in a cool, well ventilated place away from : Heat sources, Direct sunlight, incompatible materials. Keep container closed when not in use.

Incompatible products : Strong bases. Strong acids.

Incompatible materials : Sources of ignition. Direct sunlight.

Storage temperature : 15 - 20 °C

Heat-ignition : KEEP SUBSTANCE AWAY FROM: heat sources. ignition sources.

Prohibitions on mixed storage : KEEP SUBSTANCE AWAY FROM: oxidizing agents. reducing agents. strong acids. (strong) bases. halogens. amines.

Storage area : Store in a cool area. Keep out of direct sunlight. Store in a dry area. Store in a dark area. Ventilation at floor level. Fireproof storeroom. Provide for an automatic sprinkler system. Provide for a tub to collect spills. Provide the tank with earthing. Meet the legal requirements.

Special rules on packaging : SPECIAL REQUIREMENTS: closing. with pressure relief valve. clean. opaque. correctly labelled. meet the legal requirements. Secure fragile packagings in solid containers.

Packaging materials : SUITABLE MATERIAL: steel. stainless steel. carbon steel. aluminium. iron. copper. nickel. bronze. glass. MATERIAL TO AVOID: synthetic material.

SECTION 8: Exposure controls/personal protection

8.1. Control parameters

Acetone (67-64-1)		
ACGIH	ACGIH TWA (ppm)	250 ppm
ACGIH	ACGIH STEL (ppm)	500 ppm
NIOSH	NIOSH REL (TWA) (mg/m³)	590 mg/m³
NIOSH	NIOSH REL (TWA) (ppm)	250 ppm

8.2. Appropriate engineering controls

Appropriate engineering controls : Emergency eye wash fountains should be available in the immediate vicinity of any potential exposure.

8.3. Individual protection measures/Personal protective equipment

Personal protective equipment:

Safety glasses. Gloves. Protective clothing. Face shield. High gas/vapor concentration: gas mask with filter type A.

Materials for protective clothing:

GIVE GOOD RESISTANCE: butyl rubber. tetrafluoroethylene. GIVE LESS RESISTANCE: chlorosulfonated polyethylene. natural rubber. neoprene. polyurethane. PVA. styrene-butadiene rubber. GIVE POOR RESISTANCE: nitrile rubber. polyethylene. PVC. viton. nitrile rubber/PVC

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Hand protection:

Gloves

Eye protection:

Safety glasses

Skin and body protection:

Head/neck protection. Protective clothing

Respiratory protection:

Full face mask with filter type AX at conc. in air > exposure limit

Other information:

Do not eat, drink or smoke during use.

SECTION 9: Physical and chemical properties

9.1. Information on basic physical and chemical properties

Physical state	:	Liquid
Appearance	:	Liquid.
	:	Colourless
	:	Aromatic odour Sweet odour Fruity odour
Odor threshold	:	No data available
pH	:	7 (10 g/l)
Melting point	:	-95 °C
Freezing point	:	No data available
Boiling point	:	56 °C
Critical temperature	:	235 °C
Critical pressure	:	47010 hPa
Flash point	:	-17 °C (Closed cup)
Relative evaporation rate (butyl acetate=1)	:	6
Relative evaporation rate (ether=1)	:	2
Flammability (solid, gas)	:	Non flammable.
Vapor pressure	:	247 hPa (20 °C)
Vapor pressure at 50 °C	:	828 hPa
Relative vapor density at 20 °C	:	2
Relative density	:	0.79
Relative density of saturated gas/air mixture	:	1.2
Specific gravity / density	:	786 kg/m³
Molecular mass	:	58.08 g/mol
Solubility	:	Soluble in water. Soluble in ethanol. Soluble in ether. Soluble in dimethyl ether. Soluble in petroleum spirit. Soluble in chloroform. Soluble in dimethylformamide. Soluble in oils/fats. Water: complete Ethanol: complete Ether: complete
Log Pow	:	-0.24 (Test data)
Auto-ignition temperature	:	465 °C
Decomposition temperature	:	No data available
Viscosity, kinematic	:	0.417 mm²/s
Viscosity, dynamic	:	0.32 mPa·s (20 °C)
Explosion limits	:	2 - 12.8 vol % 60 - 310 g/m³ Lower explosive limit (LEL): 2 vol % UEL: 12.8 vol %
Explosive properties	:	No data available.
Oxidizing properties	:	None.

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9.2. Other information

Minimum ignition energy	:	1.15 mJ
Specific conductivity	:	6000000 pS/m (25 °C)
Saturation concentration	:	589 g/m³
VOC content	:	100 %
Other properties	:	Gas/vapour heavier than air at 20°C. Clear. Highly volatile. Neutral reaction.

SECTION 10: Stability and reactivity

10.1. Reactivity

Violent to explosive reaction with many compounds. Prolonged storage: on exposure to light: release of harmful gases/vapours.

10.2. Chemical stability

Unstable on exposure to light.

10.3. Possibility of hazardous reactions

Reacts with (strong) oxidizers.

10.4. Conditions to avoid

Direct sunlight. Extremely high or low temperatures.

10.5. Incompatible materials

Strong acids. Strong bases. Strong oxidizers.

10.6. Hazardous decomposition products

fume. Carbon monoxide. Carbon dioxide.

SECTION 11: Toxicological information

11.1. Information on toxicological effects

Likely routes of exposure	:	Inhalation; Skin and eye contact
Acute toxicity	:	Not classified

Acetone (67-64-1)	
LD50 oral rat	5800 mg/kg (Equivalent or similar to OECD 401, Rat, Female, Experimental value, Oral)
LD50 dermal rabbit	20000 mg/kg (Equivalent or similar to OECD 402, Rabbit, Male, Experimental value, Dermal)
LC50 inhalation rat (mg/l)	76 mg/l (Other, 4 h, Rat, Female, Experimental value, Inhalation (vapours))
ATE US (oral)	5800 mg/kg body weight
ATE US (dermal)	20000 mg/kg body weight
ATE US (gases)	30000 ppmV/4h
ATE US (vapors)	71 mg/l/4h
ATE US (dust, mist)	71 mg/l/4h

Skin corrosion/irritation	:	Not classified pH: 7 (10 g/l)
Serious eye damage/irritation	:	Causes serious eye irritation. pH: 7 (10 g/l)
Respiratory or skin sensitization	:	Not classified
Germ cell mutagenicity	:	Not classified Based on available data, the classification criteria are not met
Carcinogenicity	:	Not classified
Reproductive toxicity	:	Not classified Based on available data, the classification criteria are not met
Specific target organ toxicity – single exposure	:	May cause drowsiness or dizziness.
Specific target organ toxicity – repeated exposure	:	Not classified
Aspiration hazard	:	Not classified
Potential Adverse human health effects and symptoms	:	Based on available data, the classification criteria are not met.

Symptoms/effects after inhalation	:	EXPOSURE TO HIGH CONCENTRATIONS: Feeling of weakness. Irritation of the respiratory tract. Nausea. Vomiting. Headache. Central nervous system depression. Dizziness. Narcosis. Excited/restless. Drunkenness. Disturbed motor response. Respiratory difficulties. Disturbances of consciousness.
Symptoms/effects after skin contact	:	ON CONTINUOUS EXPOSURE/CONTACT: Dry skin. Cracking of the skin.
Symptoms/effects after eye contact	:	Irritation of the eye tissue.
Symptoms/effects after ingestion	:	Dry/sore throat. Risk of aspiration pneumonia. Symptoms similar to those listed under inhalation. AFTER ABSORPTION OF LARGE QUANTITIES: Irritation of the gastric/intestinal mucosa. Change in the blood composition. Change in urine output. Renal disease. Enlargement/disease of the liver.
Symptoms/effects upon intravenous administration	:	Not available.
Chronic symptoms	:	ON CONTINUOUS/REPEATED EXPOSURE/CONTACT: Red skin. Skin rash/inflammation. Dry/sore throat. Headache. Nausea. Feeling of weakness. Loss of weight. Possible inflammation of the respiratory tract.

SECTION 12: Ecological information

12.1. Toxicity

Ecology - general	:	Not classified as dangerous for the environment according to the criteria of Regulation (EC) No 1272/2008.
Ecology - air	:	Not included in the list of substances which may contribute to the greenhouse effect (IPCC). Not included in the list of fluorinated greenhouse gases (Regulation (EU) No 517/2014). Not classified as dangerous for the ozone layer (Regulation (EC) No 1005/2009).
Ecology - water	:	Not harmful to crustacea. Not harmful to fishes. Inhibition of activated sludge. Not harmful to algae. Not harmful to plankton.

Acetone (67-64-1)	
LC50 fish 1	5540 mg/l (EU Method C.1, 96 h, Salmo gairdneri, Static system, Fresh water, Experimental value, Nominal concentration)

12.2. Persistence and degradability

Acetone (67-64-1)	
Persistence and degradability	Biodegradable in the soil. Biodegradable in the soil under anaerobic conditions. Readily biodegradable in water.
Biochemical oxygen demand (BOD)	1.43 g O_2/g substance
Chemical oxygen demand (COD)	1.92 g O_2/g substance
ThOD	2.2 g O_2/g substance
BOD (% of ThOD)	0.872 (20 day(s), Literature study)

12.3. Bioaccumulative potential

Acetone (67-64-1)	
BCF fish 1	0.69 (Pisces)
BCF other aquatic organisms 1	3 (BCFWIN, Calculated value)
Log Pow	-0.24 (Test data)
Bioaccumulative potential	Not bioaccumulative.

12.4. Mobility in soil

Acetone (67-64-1)	
Surface tension	0.0237 N/m
Ecology - soil	No (test)data on mobility of the substance available.

12.5. Other adverse effects

Other information : Avoid release to the environment.

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SECTION 13: Disposal considerations

13.1. Disposal methods

Waste disposal recommendations : Do not discharge into drains or the environment. Remove waste in accordance with local and/or national regulations. Hazardous waste shall not be mixed together with other waste. Different types of hazardous waste shall not be mixed together if this may entail a risk of pollution or create problems for the further management of the waste. Hazardous waste shall be managed responsibly. All entities that store, transport or handle hazardous waste shall take the necessary measures to prevent risks of pollution or damage to people or animals. Recycle by distillation. Incinerate under surveillance with energy recovery.

Additional information : Hazardous waste according to Directive 2008/98/EC, as amended by Regulation (EU) No 1357/2014 and Regulation (EU) No 2017/997.

Ecology - waste materials : Avoid release to the environment.

SECTION 14: Transport information

Department of Transportation (DOT)

In accordance with DOT

Transport document description : UN1090 Acetone, 3, II

UN-No.(DOT) : UN1090

Proper Shipping Name (DOT) : Acetone

Transport hazard class(es) (DOT) : 3 - Class 3 - Flammable and combustible liquid 49 CFR 173.120

Packing group (DOT) : II - Medium Danger

Hazard labels (DOT) : 3 - Flammable liquid

DOT Packaging Non Bulk (49 CFR 173.xxx) : 202

DOT Packaging Bulk (49 CFR 173.xxx) : 242

DOT Special Provisions (49 CFR 172.102) : IB2 - Authorized IBCs: Metal (31A, 31B and 31N); Rigid plastics (31H1 and 31H2); Composite (31HZ1). Additional Requirement: Only liquids with a vapor pressure less than or equal to 110 kPa at 50 C (1.1 bar at 122 F), or 130 kPa at 55 C (1.3 bar at 131 F) are authorized.
T4 - 2.65 178.274(d)(2) Normal..... 178.275(d)(3)
TP1 - The maximum degree of filling must not exceed the degree of filling determined by the following: Degree of filling = 97 / 1 + a (tr - tf) Where: tr is the maximum mean bulk temperature during transport, and tf is the temperature in degrees celsius of the liquid during filling.

DOT Packaging Exceptions (49 CFR 173.xxx) : 150

DOT Quantity Limitations Passenger aircraft/rail (49 CFR 173.27) : 5 L

DOT Quantity Limitations Cargo aircraft only (49 CFR 175.75) : 60 L

DOT Vessel Stowage Location : B - (i) The material may be stowed "on deck" or "under deck" on a cargo vessel and on a passenger vessel carrying a number of passengers limited to not more than the larger of 25 passengers, or one passenger per each 3 m of overall vessel length; and (ii) "On deck only" on passenger vessels in which the number of passengers specified in paragraph (k)(2)(i) of this section is exceeded.

Other information : No supplementary information available.

Transportation of Dangerous Goods

Transport document description : UN1090 ACETONE, 3, II

UN-No. (TDG) : UN1090

Proper Shipping Name (Transportation of Dangerous Goods) : ACETONE

TDG Primary Hazard Classes : 3 - Class 3 - Flammable Liquids

Packing group : II - Medium Danger

Explosive Limit and Limited Quantity Index : 1 L

Passenger Carrying Road Vehicle or Passenger Carrying Railway Vehicle Index : 5 L

Passenger Carrying Ship Index : Forbidden

Transport by sea

Transport document description (IMDG)	:	UN 1090 acetone, 3, II
UN-No. (IMDG)	:	1090
Proper Shipping Name (IMDG)	:	acetone
Class (IMDG)	:	3 - Flammable liquids
Packing group (IMDG)	:	II - substances presenting medium danger
EmS-No. (1)	:	F-E
EmS-No. (2)	:	S-D

Air transport

Transport document description (IATA)	:	UN 1090 Acetone, 3, II
UN-No. (IATA)	:	1090
Proper Shipping Name (IATA)	:	Acetone
Class (IATA)	:	3 - Flammable Liquids
Packing group (IATA)	:	II - Medium Danger

SECTION 15: Regulatory information

15.1. US Federal regulations

Acetone (67-64-1)	
Listed on the United States TSCA (Toxic Substances Control Act) inventory	
RQ (Reportable quantity, section 304 of EPA's List of Lists)	5000 lb
SARA Section 311/312 Hazard Classes	Immediate (acute) health hazard Fire hazard

All components of this product are listed, or excluded from listing, on the United States Environmental Protection Agency Toxic Substances Control Act (TSCA) inventory

15.2. International regulations

CANADA

Acetone (67-64-1)
Listed on the Canadian DSL (Domestic Substances List)

EU-Regulations

No additional information available

National regulations

Acetone (67-64-1)
Listed on the Canadian IDL (Ingredient Disclosure List)

15.3. US State regulations

California Proposition 65 - This product does not contain any substances known to the state of California to cause cancer, developmental and/or reproductive harm

SECTION 16: Other information

Revision date	:	04/24/2018
Other information	:	None.

Full text of H-phrases: see section 16:

H225	Highly flammable liquid and vapour
H319	Causes serious eye irritation
H336	May cause drowsiness or dizziness

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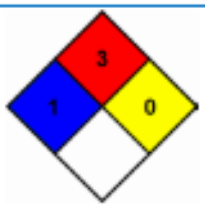
NFPA health hazard	:	1 - Materials that, under emergency conditions, can cause significant irritation.
NFPA fire hazard	:	3 - Liquids and solids (including finely divided suspended solids) that can be ignited under almost all ambient temperature conditions.
NFPA reactivity	:	0 - Material that in themselves are normally stable, even under fire conditions.



Hazard Rating

Health	:	1 Slight Hazard - Irritation or minor reversible injury possible
Flammability	:	3 Serious Hazard - Materials capable of ignition under almost all normal temperature conditions. Includes flammable liquids with flash points below 73 F and boiling points above 100 F, as well as liquids with flash points between 73 F and 100 F. (Classes IB & IC)
Physical	:	0 Minimal Hazard - Materials that are normally stable, even under fire conditions, and will NOT react with water, polymerize, decompose, condense, or self-react. Non-Explosives.
Personal protection	:	C C - Safety glasses, Gloves, Synthetic apron

SDS US LabChem

Information in this SDS is from available published sources and is believed to be accurate. No warranty, express or implied, is made and LabChem Inc assumes no liability resulting from the use of this SDS. The user must determine suitability of this information for his application.

9.4.Security sheet Gum Arabic

ThermoFisher SCIENTIFIC

SAFETY DATA SHEET

Revision Date 19-Jan-2018 Revision Number 3

1. Identification

Product Name	Gum arabic
Cat No. :	AC258850000; AC258850010; AC258850025; AC258852500
CAS-No	9000-01-5
Synonyms	Acacia
Recommended Use	Laboratory chemicals.
Uses advised against	Not for food, drug, pesticide or biocidal product use

Details of the supplier of the safety data sheet

Company

Fisher Scientific
One Reagent Lane
Fair Lawn, NJ 07410
Tel: (201) 796-7100

Acros Organics
One Reagent Lane
Fair Lawn, NJ 07410

Emergency Telephone Number
For information US call: 001-800-ACROS-01 / Europe call: +32 14 57 52 11
Emergency Number US:001-201-796-7100 / Europe: +32 14 57 52 99
CHEMTREC Tel. No.US:001-800-424-9300 / Europe:001-703-527-3887

2. Hazard(s) identification

Classification

This chemical is considered hazardous by the 2012 OSHA Hazard Communication Standard (29 CFR 1910.1200)

Combustible dust	Yes

Label Elements

Signal Word
Warning

Hazard Statements
May form combustible dust concentrations in air

Precautionary Statements
Storage
Store in a well-ventilated place. Keep container tightly closed
Hazards not otherwise classified (HNOC)
None identified

3. Composition/Information on Ingredients

Component	CAS-No	Weight %
Gum arabic	9000-01-5	>95

4. First-aid measures

Eye Contact	Rinse immediately with plenty of water, also under the eyelids, for at least 15 minutes. Get medical attention.
Skin Contact	Wash off immediately with plenty of water for at least 15 minutes. Get medical attention immediately if symptoms occur.
Inhalation	Move to fresh air. Get medical attention immediately if symptoms occur.
Ingestion	Clean mouth with water and drink afterwards plenty of water. Get medical attention if symptoms occur.
Most important symptoms and effects	None reasonably foreseeable.
Notes to Physician	Treat symptomatically

5. Fire-fighting measures

Suitable Extinguishing Media	Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide.
Unsuitable Extinguishing Media	No information available
Flash Point	No information available
Method -	No information available
Autoignition Temperature	
Explosion Limits	
Upper	No data available
Lower	No data available
Sensitivity to Mechanical Impact	No information available
Sensitivity to Static Discharge	No information available

Specific Hazards Arising from the Chemical
Dust can form an explosive mixture in air. Fine dust dispersed in air may ignite.

Hazardous Combustion Products
Thermal decomposition can lead to release of irritating gases and vapors
Protective Equipment and Precautions for Firefighters
As in any fire, wear self-contained breathing apparatus pressure-demand, MSHA/NIOSH (approved or equivalent) and full protective gear.

NFPA

Health	Flammability	Instability	Physical hazards
1	1	0	N/A

6. Accidental release measures

Personal Precautions	Ensure adequate ventilation. Use personal protective equipment. Avoid dust formation.
Environmental Precautions	Should not be released into the environment. See Section 12 for additional ecological information.
Methods for Containment and Clean Up	Sweep up or vacuum up spillage and collect in suitable container for disposal. Avoid dust formation.

7. Handling and storage

Handling	Wear personal protective equipment. Ensure adequate ventilation. Avoid contact with skin, eyes and clothing. Avoid ingestion and inhalation. Avoid dust formation.
Storage	Keep containers tightly closed in a dry, cool and well-ventilated place.

8. Exposure controls / personal protection

Exposure Guidelines	This product does not contain any hazardous materials with occupational exposure limitsestablished by the region specific regulatory bodies.
Engineering Measures	None under normal use conditions.
Personal Protective Equipment	
Eye/face Protection	Wear appropriate protective eyeglasses or chemical safety goggles as described by OSHA's eye and face protection regulations in 29 CFR 1910.133 or European Standard EN166.
Skin and body protection	Wear appropriate protective gloves and clothing to prevent skin exposure.
Respiratory Protection	No protective equipment is needed under normal use conditions.
Hygiene Measures	Handle in accordance with good industrial hygiene and safety practice.

9. Physical and chemical properties

Physical State	Solid
Appearance	Beige
Odor	No information available
Odor Threshold	No information available
pH	7 100g/l aq.sol.(20°C)
Melting Point/Range	No data available
Boiling Point/Range	No information available
Flash Point	No information available
Evaporation Rate	Not applicable
Flammability (solid,gas)	No information available
Flammability or explosive limits	
Upper	No data available
Lower	No data available
Vapor Pressure	negligible
Vapor Density	Not applicable
Specific Gravity	1.350
Solubility	No information available
Partition coefficient; n-octanol/water	No data available
Autoignition Temperature	
Decomposition Temperature	90 °C
Viscosity	Not applicable

10. Stability and reactivity

Reactive Hazard	None known, based on information available
Stability	Stable under normal conditions.
Conditions to Avoid	Incompatible products. Excess heat. Avoid dust formation.
Incompatible Materials	Strong oxidizing agents

Hazardous Decomposition Products Thermal decomposition can lead to release of irritating gases and vapors

Hazardous Polymerization Hazardous polymerization does not occur.

Hazardous Reactions None under normal processing.

11. Toxicological information

Acute Toxicity

Product Information
Component Information

Component	LD50 Oral	LD50 Dermal	LC50 Inhalation
Gum arabic	>16 g/kg (Rat)	Not listed	Not listed

Toxicologically Synergistic Products: No information available

Delayed and immediate effects as well as chronic effects from short and long-term exposure

Irritation: No information available

Sensitization: No information available

Carcinogenicity: The table below indicates whether each agency has listed any ingredient as a carcinogen.

Component	CAS-No	IARC	NTP	ACGIH	OSHA	Mexico
Gum arabic	9000-01-5	Not listed	Not listed	Not listed	Not listed	Not listed

Mutagenic Effects: Not mutagenic in AMES Test

Reproductive Effects: No information available.

Developmental Effects: No information available.

Teratogenicity: No information available.

STOT - single exposure: None known
STOT - repeated exposure: None known

Aspiration hazard: No information available

Symptoms / effects,both acute and delayed: No information available

Endocrine Disruptor Information: No information available

Other Adverse Effects: The toxicological properties have not been fully investigated.

12. Ecological information

Ecotoxicity
Do not empty into drains. .

Persistence and Degradability: Soluble in water Persistence is unlikely based on information available.

Bioaccumulation/ Accumulation: No information available.

Mobility: Will likely be mobile in the environment due to its water solubility.

13. Disposal considerations

Waste Disposal Methods: Chemical waste generators must determine whether a discarded chemical is classified as a hazardous waste. Chemical waste generators must also consult local, regional, and national hazardous waste regulations to ensure complete and accurate classification.

14. Transport information

DOT	Not regulated
TDG	Not regulated
IATA	Not regulated
IMDG/IMO	Not regulated

15. Regulatory information

All of the components in the product are on the following Inventory lists: X = listed

International Inventories

Component	TSCA	DSL	NDSL	EINECS	ELINCS	NLP	PICCS	ENCS	AICS	IECSC	KECL
Gum arabic	X	X	-	232-519-5	-		X	-	X	X	X

Legend:
X - Listed
E - Indicates a substance that is the subject of a Section 5(e) Consent order under TSCA.
F - Indicates a substance that is the subject of a Section 5(f) Rule under TSCA.
N - Indicates a polymeric substance containing no free-radical initiator in its inventory name but is considered to cover the designated polymer made with any free-radical initiator regardless of the amount used.
P - Indicates a commenced PMN substance
R - Indicates a substance that is the subject of a Section 6 risk management rule under TSCA.
S - Indicates a substance that is identified in a proposed or final Significant New Use Rule
T - Indicates a substance that is the subject of a Section 4 test rule under TSCA.
XU - Indicates a substance exempt from reporting under the Inventory Update Rule, i.e. Partial Updating of the TSCA Inventory Data Base Production and Site Reports (40 CFR 710(B).
Y1 - Indicates an exempt polymer that has a number-average molecular weight of 1,000 or greater.
Y2 - Indicates an exempt polymer that is a polyester and is made only from reactants included in a specified list of low concern reactants that comprises one of the eligibility criteria for the exemption rule.

U.S. Federal Regulations

TSCA 12(b)	Not applicable
SARA 313	Not applicable
SARA 311/312 Hazard Categories	See section 2 for more information
CWA (Clean Water Act)	Not applicable
Clean Air Act	Not applicable

OSHA Occupational Safety and Health Administration
Not applicable

CERCLA	Not applicable
California Proposition 65	This product does not contain any Proposition 65 chemicals
U.S. State Right-to-Know Regulations	Not applicable

U.S. Department of Transportation

Reportable Quantity (RQ):	N
DOT Marine Pollutant	N
DOT Severe Marine Pollutant	N

U.S. Department of Homeland Security
This product does not contain any DHS chemicals.

Other International Regulations

Mexico - Grade	No information available

16. Other information

Prepared By	Regulatory Affairs Thermo Fisher Scientific Email: EMSDS.RA@thermofisher.com
Revision Date	19-Jan-2018
Print Date	19-Jan-2018
Revision Summary	This document has been updated to comply with the US OSHA HazCom 2012 Standard replacing the current legislation under 29 CFR 1910.1200 to align with the Globally Harmonized System of Classification and Labeling of Chemicals (GHS).

Disclaimer
The information provided in this Safety Data Sheet is correct to the best of our knowledge, information and belief at the date of its publication. The information given is designed only as a guidance for safe handling, use, processing, storage, transportation, disposal and release and is not to be considered a warranty or quality specification. The information relates only to the specific material designated and may not be valid for such material used in combination with any other materials or in any process, unless specified in the text

End of SDS

9.5.Security data sheet β-carotene

Cayman Chemical

SAFETY DATA SHEET
.beta.-Carotene

Revision: 03/27/2019
Supersedes Revision: 02/14/2015

according to Regulation (EC) No. 1907/2006 as amended by (EC) No. 2015/830 and US OSHA HCS 2015

Section 1. Identification of the Substance/Mixture and of the Company/Undertaking

1.1 Product Code: 16837

Product Name: .beta.-Carotene

Synonyms: .beta.,.beta.-carotene; Food Orange 5; KPMK; Lucarotin; NSC 62794; Provatene; Provitamin A; Solatene;

1.2 Relevant identified uses of the substance or mixture and uses advised against:

Relevant identified uses: For research use only, not for human or veterinary use.

1.3 Details of the Supplier of the Safety Data Sheet:

Company Name: Cayman Chemical Company
1180 E. Ellsworth Rd.
Ann Arbor, MI 48108

Web site address: www.caymanchem.com

Information: Cayman Chemical Company +1 (734)971-3335

1.4 Emergency telephone number:

Emergency Contact: CHEMTREC Within USA and Canada: +1 (800)424-9300
CHEMTREC Outside USA and Canada: +1 (703)527-3887

Section 2. Hazards Identification

2.1 Classification of the Substance or Mixture:

Self-Heating Substances, Category 2

Serious Eye Damage/Eye Irritation, Category 2

2.2 Label Elements:

GHS Signal Word: **Warning**

GHS Hazard Phrases:

H252: Self-heating in large quantities; may catch fire.

H319: Causes serious eye irritation.

GHS Precaution Phrases:

P235: Keep cool.

P264: Wash {hands} thoroughly after handling.

P280: Wear {protective gloves/protective clothing/eye protection/face protection}.

GHS Response Phrases:

P305+351+338: IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.

P337+313: If eye irritation persists, get medical advice/attention.

GHS Storage and Disposal Phrases:

Please refer to Section 7 for Storage and Section 13 for Disposal information.

2.3 Adverse Human Health Effects and Symptoms: Causes serious eye irritation.
Material may be irritating to the mucous membranes and upper respiratory tract.
May be harmful by inhalation, ingestion, or skin absorption.
May cause skin or respiratory system irritation.
Self-heating in large quantities; may catch fire.
To the best of our knowledge, the toxicological properties have not been thoroughly investigated.

Section 3. Composition/Information on Ingredients

CAS # / RTECS #	Hazardous Components (Chemical Name)/ REACH Registration No.	Concentration	EC No./ EC Index No.	GHS Classification
7235-40-7 FI0329500	.beta.,.beta.-Carotene 01-2119957394-26	100.0 %	230-636-6 NA	Self-Heat. 2: H252 Eye Damage 2: H319

Section 4. First Aid Measures

4.1 Description of First Aid Measures:

In Case of Inhalation: Remove to fresh air. If not breathing, give artificial respiration or give oxygen by trained personnel. Get immediate medical attention.

In Case of Skin Contact: Immediately wash skin with soap and plenty of water for at least 15 minutes. Remove contaminated clothing. Get medical attention if symptoms occur. Wash clothing before reuse.

In Case of Eye Contact: Hold eyelids apart and flush eyes with plenty of water for at least 15 minutes. Have eyes examined and tested by medical personnel.

In Case of Ingestion: Wash out mouth with water provided person is conscious. Never give anything by mouth to an unconscious person. Get medical attention. Do NOT induce vomiting unless directed to do so by medical personnel.

Section 5. Fire Fighting Measures

5.1 Suitable Extinguishing Media: Use alcohol-resistant foam, carbon dioxide, water, or dry chemical spray.
Use water spray to cool fire-exposed containers.

Unsuitable Extinguishing Media: A solid water stream may be inefficient.

5.2 Flammable Properties and Hazards: No data available.

No data available.

Flash Pt: No data.

Explosive Limits: LEL: No data. UEL: No data.

Autoignition Pt: No data.

5.3 Fire Fighting Instructions: As in any fire, wear self-contained breathing apparatus pressure-demand (NIOSH approved or equivalent), and full protective gear to prevent contact with skin and eyes.

Section 6. Accidental Release Measures

6.1	**Protective Precautions, Protective Equipment and Emergency Procedures:**	Avoid raising and breathing dust, and provide adequate ventilation. As conditions warrant, wear a NIOSH approved self-contained breathing apparatus, or respirator, and appropriate personal protection (rubber boots, safety goggles, and heavy rubber gloves).
6.2	**Environmental Precautions:**	Take steps to avoid release into the environment, if safe to do so.
6.3	**Methods and Material For Containment and Cleaning Up:**	Contain spill and collect, as appropriate. Transfer to a chemical waste container for disposal in accordance with local regulations.

Section 7. Handling and Storage

7.1	**Precautions To Be Taken in Handling:**	Avoid breathing dust/fume/gas/mist/vapours/spray. Avoid prolonged or repeated exposure.
7.2	**Precautions To Be Taken in Storing:**	Keep container tightly closed. Store in accordance with information listed on the product insert.
	Other Precautions:	Air sensitive. Light sensitive.

Section 8. Exposure Controls/Personal Protection

8.1	**Exposure Parameters:**	
8.2	**Exposure Controls:**	
8.2.1	**Engineering Controls (Ventilation etc.):**	Use process enclosures, local exhaust ventilation, or other engineering controls to control airborne levels below recommended exposure limits.
8.2.2	**Personal protection equipment:**	
	Eye Protection:	Safety glasses
	Protective Gloves:	Compatible chemical-resistant gloves
	Other Protective Clothing:	Lab coat
	Respiratory Equipment (Specify Type):	NIOSH approved respirator, as conditions warrant.
	Work/Hygienic/Maintenance Practices:	Do not take internally. Facilities storing or utilizing this material should be equipped with an eyewash facility and a safety shower. Wash thoroughly after handling. No data available.

Section 9. Physical and Chemical Properties

9.1 Information on Basic Physical and Chemical Properties

Physical States:	[ ] Gas [ ] Liquid [X] Solid
Appearance and Odor:	A crystalline solid
pH:	No data.
Melting Point:	No data.
Boiling Point:	No data.
Flash Pt:	No data.
Evaporation Rate:	No data.
Flammability (solid, gas):	No data available.
Explosive Limits:	LEL: No data. UEL: No data.
Vapor Pressure (vs. Air or mm Hg):	No data.
Vapor Density (vs. Air = 1):	No data.
Specific Gravity (Water = 1):	No data.
Solubility in Water:	No data.
Solubility Notes:	~0.1 mg/ml in a 1:10 solution of DMSO:PBS (pH 7.2); ~1 mg/ml in DMSO; ~0.14 mg/ml in DMF;
Octanol/Water Partition Coefficient:	No data.
Autoignition Pt:	No data.
Decomposition Temperature:	No data.
Viscosity:	No data.

9.2 Other Information

Percent Volatile:	No data.
Molecular Formula & Weight:	C40H56 536.9

Section 10. Stability and Reactivity

10.1	**Reactivity:**	No data available.
10.2	**Stability:**	Unstable [ ] Stable [X]
10.3	**Stability Note(s):**	Stable if stored in accordance with information listed on the product insert.
	Polymerization:	Will occur [ ] Will not occur [X]
10.4	**Conditions To Avoid:**	No data available.
10.5	**Incompatibility - Materials To Avoid:**	acids strong oxidizing agents
10.6	**Hazardous Decomposition or Byproducts:**	carbon dioxide carbon monoxide

Section 11. Toxicological Information

11.1 Information on Toxicological Effects: The toxicological effects of this product have not been thoroughly studied.
.beta.-Carotene - Toxicity Data: Intraperitoneal TDLO (mouse): 5 ng/kg; Oral TDLO (human): 130.4 mg/kg/1Y (intermittent); Oral TDLO (rat): 0.05 mg/kg/3D (intermittent); Intraperitoneal TDLO (rat): 240 mg/kg/24D (intermittent);

Chronic Toxicological Effects: .beta.-Carotene - Investigated as a drug, mutagen, natural product, and tumorigen.
Only select Registry of Toxic Effects of Chemical Substances (RTECS) data is presented here. See actual entry in RTECS for complete information.
.beta.-Carotene RTECS Number: FI0329500

CAS #	Hazardous Components (Chemical Name)	NTP	IARC	ACGIH	OSHA
7235-40-7	.beta.,.beta.-Carotene	n.a.	n.a.	n.a.	n.a.

Section 12. Ecological Information

12.1 Toxicity: Avoid release into the environment.
Runoff from fire control or dilution water may cause pollution.

12.2 Persistence and Degradability: No data available.

12.3 Bioaccumulative Potential: No data available.

12.4 Mobility in Soil: No data available.

12.5 Results of PBT and vPvB assessment: No data available.

12.6 Other adverse effects: No data available.

Section 13. Disposal Considerations

13.1 Waste Disposal Method: Dispose in accordance with local, state, and federal regulations.

Section 14. Transport Information

14.1 LAND TRANSPORT (US DOT):

DOT Proper Shipping Name: Not dangerous goods.
DOT Hazard Class:
UN/NA Number:

14.1 LAND TRANSPORT (European ADR/RID):

ADR/RID Shipping Name: Not dangerous goods.
UN Number:
Hazard Class:

14.3 AIR TRANSPORT (ICAO/IATA):

ICAO/IATA Shipping Name: Not dangerous goods.

Additional Transport Information: Transport in accordance with local, state, and federal regulations.

Section 15. Regulatory Information

EPA SARA (Superfund Amendments and Reauthorization Act of 1986) Lists

CAS #	Hazardous Components (Chemical Name)	S. 302 (EHS)	S. 304 RQ	S. 313 (TRI)
7235-40-7	.beta.,.beta.-Carotene	No	No	No

CAS #	Hazardous Components (Chemical Name)	Other US EPA or State Lists
7235-40-7	.beta.,.beta.-Carotene	CAA HAP,ODC: No; CWA NPDES: No; TSCA: Yes - Inventory; CA PROP.65: No

Regulatory Information Statement: This SDS was prepared in accordance with 29 CFR 1910.1200 and Regulation (EC) No.1272/2008.

Section 16. Other Information

Revision Date: 03/27/2019

Additional Information About This Product: No data available.

Company Policy or Disclaimer: DISCLAIMER: This information is believed to be accurate and represents the best information currently available to us. However, we make no warranty of merchantability or any other warranty, express or implied, with respect to such information, and we assume no liability resulting from its use. Users should make their own investigations to determine the suitability of the information for their particular purposes.

9.6.Security data sheet Dichloromethane

SIGMA-ALDRICH

sigma-aldrich.com

SAFETY DATA SHEET

Version 5.3
Revision Date 02/20/2014
Print Date 03/03/2014

1. PRODUCT AND COMPANY IDENTIFICATION

1.1 Product identifiers

Product name : Dichloromethane

Product Number : 270997
Brand : Sigma-Aldrich
Index-No. : 602-004-00-3
REACH No. : 01-2119480404-41-XXXX
CAS-No. : 75-09-2

1.2 Relevant identified uses of the substance or mixture and uses advised against

Identified uses : Laboratory chemicals, Manufacture of substances

1.3 Details of the supplier of the safety data sheet

Company : Sigma-Aldrich
3050 Spruce Street
SAINT LOUIS MO 63103
USA

Telephone : +1 800-325-5832
Fax : +1 800-325-5052

1.4 Emergency telephone number

Emergency Phone # : (314) 776-6555

2. HAZARDS IDENTIFICATION

2.1 Classification of the substance or mixture

GHS Classification in accordance with 29 CFR 1910 (OSHA HCS)
Skin irritation (Category 2), H315
Eye irritation (Category 2A), H319
Carcinogenicity (Category 2), H351
Specific target organ toxicity - single exposure (Category 3), Respiratory system, Central nervous system, H335, H336
Specific target organ toxicity - repeated exposure, Oral (Category 2), Liver, Blood, H373
Specific target organ toxicity - repeated exposure, Inhalation (Category 2), Central nervous system, H373

For the full text of the H-Statements mentioned in this Section, see Section 16.

2.2 GHS Label elements, including precautionary statements

Pictogram

Signal word Warning

Hazard statement(s)
H315 Causes skin irritation.
H319 Causes serious eye irritation.
H335 May cause respiratory irritation.
H336 May cause drowsiness or dizziness.
H351 Suspected of causing cancer.
H373 May cause damage to organs (Liver, Blood) through prolonged or repeated exposure if swallowed.
H373 May cause damage to organs (Central nervous system) through prolonged or repeated exposure if inhaled.

Precautionary statement(s)	
P201	Obtain special instructions before use.
P202	Do not handle until all safety precautions have been read and understood.
P260	Do not breathe dust/ fume/ gas/ mist/ vapours/ spray.
P264	Wash skin thoroughly after handling.
P271	Use only outdoors or in a well-ventilated area.
P280	Wear protective gloves/ eye protection/ face protection.
P302 + P352	IF ON SKIN: Wash with plenty of soap and water.
P304 + P340	IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing.
P305 + P351 + P338	IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.
P308 + P313	IF exposed or concerned: Get medical advice/ attention.
P321	Specific treatment (see supplemental first aid instructions on this label).
P332 + P313	If skin irritation occurs: Get medical advice/ attention.
P337 + P313	If eye irritation persists: Get medical advice/ attention.
P362	Take off contaminated clothing and wash before reuse.
P403 + P233	Store in a well-ventilated place. Keep container tightly closed.
P405	Store locked up.
P501	Dispose of contents/ container to an approved waste disposal plant.

2.3 Hazards not otherwise classified (HNOC) or not covered by GHS - none

3. COMPOSITION/INFORMATION ON INGREDIENTS

3.1 Substances

Synonyms	:	Methylene chloride DCM
Formula	:	CH_2Cl_2
Molecular Weight	:	84.93 g/mol
CAS-No.	:	75-09-2
EC-No.	:	200-838-9
Index-No.	:	602-004-00-3
Registration number	:	01-2119480404-41-XXXX

Hazardous components

Component	Classification	Concentration
Methylene chloride		
	Skin Irrit. 2; Eye Irrit. 2A; Carc. 2; STOT SE 3; STOT RE 2; H315, H319, H335, H336, H351, H373, H373	90 - 100 %

For the full text of the H-Statements mentioned in this Section, see Section 16.

4. FIRST AID MEASURES

4.1 Description of first aid measures

General advice
Consult a physician. Show this safety data sheet to the doctor in attendance.Move out of dangerous area.

If inhaled
If breathed in, move person into fresh air. If not breathing, give artificial respiration. Consult a physician.

In case of skin contact
Wash off with soap and plenty of water. Consult a physician.

In case of eye contact
Rinse thoroughly with plenty of water for at least 15 minutes and consult a physician.

If swallowed
Never give anything by mouth to an unconscious person. Rinse mouth with water. Consult a physician.

4.2 Most important symptoms and effects, both acute and delayed
The most important known symptoms and effects are described in the labelling (see section 2.2) and/or in section 11

4.3 Indication of any immediate medical attention and special treatment needed
no data available

5. FIREFIGHTING MEASURES

5.1 Extinguishing media

Suitable extinguishing media
Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide.

5.2 Special hazards arising from the substance or mixture
no data available

5.3 Advice for firefighters
Wear self contained breathing apparatus for fire fighting if necessary.

5.4 Further information
no data available

6. ACCIDENTAL RELEASE MEASURES

6.1 Personal precautions, protective equipment and emergency procedures
Use personal protective equipment. Avoid breathing vapours, mist or gas. Ensure adequate ventilation. Evacuate personnel to safe areas.
For personal protection see section 8.

6.2 Environmental precautions
Prevent further leakage or spillage if safe to do so. Do not let product enter drains.

6.3 Methods and materials for containment and cleaning up
Soak up with inert absorbent material and dispose of as hazardous waste. Keep in suitable, closed containers for disposal.

6.4 Reference to other sections
For disposal see section 13.

7. HANDLING AND STORAGE

7.1 Precautions for safe handling
Avoid contact with skin and eyes. Avoid inhalation of vapour or mist.
For precautions see section 2.2.

7.2 Conditions for safe storage, including any incompatibilities
Keep container tightly closed in a dry and well-ventilated place. Containers which are opened must be carefully resealed and kept upright to prevent leakage.

Heat sensitive. Store under inert gas.

7.3 Specific end use(s)
Apart from the uses mentioned in section 1.2 no other specific uses are stipulated

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

8.1 Control parameters

Components with workplace control parameters

Component	CAS-No.	Value	Control parameters	Basis
	Remarks	Potential Occupational Carcinogen See Appendix A		

Methylene chloride	75-09-2	TWA	50 ppm	USA. ACGIH Threshold Limit Values (TLV)
		Central Nervous System impairment Carboxyhemoglobinemia Substances for which there is a Biological Exposure Index or Indices (see BEI® section) Confirmed animal carcinogen with unknown relevance to humans		
		Substance listed; for more information see OSHA document 1910.1052		
		See 1910.1052		
		See Table Z-2		
		PEL	25 ppm	OSHA Specifically Regulated Chemicals/Carcinogens
		1910.1052 This section applies to all occupational exposures to methylene chloride (MC), Chemical Abstracts Service Registry Number 75-09-2, in general industry, construction and shipyard employment. Methylene chloride (MC) means an organic compound with chemical formula, CH2Cl2. Its Chemical Abstracts Service Registry Number is 75-09-2. Its molecular weight is 84.9 g/mole OSHA specifically regulated carcinogen		
		STEL	125 ppm	OSHA Specifically Regulated Chemicals/Carcinogens
		1910.1052 This section applies to all occupational exposures to methylene chloride (MC), Chemical Abstracts Service Registry Number 75-09-2, in general industry, construction and shipyard employment. Methylene chloride (MC) means an organic compound with chemical formula, CH2Cl2. Its Chemical Abstracts Service Registry Number is 75-09-2. Its molecular weight is 84.9 g/mole OSHA specifically regulated carcinogen		

Biological occupational exposure limits

Component	CAS-No.	Parameters	Value	Biological specimen	Basis
Methylene chloride	75-09-2	Dichloromethane	0.3 mg/l	Urine	ACGIH - Biological Exposure Indices (BEI)
	Remarks	End of shift (As soon as possible after exposure ceases)			

8.2 Exposure controls

Appropriate engineering controls
Handle in accordance with good industrial hygiene and safety practice. Wash hands before breaks and at the end of workday.

Personal protective equipment

Eye/face protection
Face shield and safety glasses Use equipment for eye protection tested and approved under appropriate government standards such as NIOSH (US) or EN 166(EU).

Skin protection
Handle with gloves. Gloves must be inspected prior to use. Use proper glove removal technique (without touching glove's outer surface) to avoid skin contact with this product. Dispose of contaminated gloves after use in accordance with applicable laws and good laboratory practices. Wash and dry hands.

Splash contact
Material: Fluorinated rubber
Minimum layer thickness: 0.7 mm
Break through time: 148 min
Material tested:Vitoject® (KCL 890 / Aldrich Z677698, Size M)

data source: KCL GmbH, D-36124 Eichenzell, phone +49 (0)6659 87300, e-mail sales@kcl.de, test method: EN374
If used in solution, or mixed with other substances, and under conditions which differ from EN 374, contact the supplier of the CE approved gloves. This recommendation is advisory only and must be evaluated by an industrial hygienist and safety officer familiar with the specific situation of anticipated use by our customers. It should not be construed as offering an approval for any specific use scenario.

Body Protection
Complete suit protecting against chemicals, The type of protective equipment must be selected according to the concentration and amount of the dangerous substance at the specific workplace.

Respiratory protection
Where risk assessment shows air-purifying respirators are appropriate use a full-face respirator with multi-purpose combination (US) or type AXBEK (EN 14387) respirator cartridges as a backup to engineering controls. If the respirator is the sole means of protection, use a full-face supplied air respirator. Use respirators and components tested and approved under appropriate government standards such as NIOSH (US) or CEN (EU).

Control of environmental exposure
Prevent further leakage or spillage if safe to do so. Do not let product enter drains.

9. PHYSICAL AND CHEMICAL PROPERTIES

9.1 Information on basic physical and chemical properties

a)	Appearance	Form: liquid Colour: colourless
b)	Odour	no data available
c)	Odour Threshold	no data available
d)	pH	no data available
e)	Melting point/freezing point	Melting point/range: -97 °C (-143 °F)
f)	Initial boiling point and boiling range	39.8 - 40 °C (103.6 - 104 °F)
g)	Flash point	no data available
h)	Evapouration rate	0.71
i)	Flammability (solid, gas)	no data available
j)	Upper/lower flammability or explosive limits	Upper explosion limit: 19 %(V) Lower explosion limit: 12 %(V)
k)	Vapour pressure	470.9 hPa (353.2 mmHg) at 20.0 °C (68.0 °F)
l)	Vapour density	2.93 - (Air = 1.0)
m)	Relative density	1.325 g/mL at 25 °C (77 °F)
n)	Water solubility	slightly soluble
o)	Partition coefficient: n-octanol/water	log Pow: 1.25
p)	Auto-ignition temperature	556.1 °C (1,033.0 °F) 662.0 °C (1,223.6 °F)
q)	Decomposition temperature	no data available
r)	Viscosity	no data available
s)	Explosive properties	no data available
t)	Oxidizing properties	no data available

9.2 Other safety information

Relative vapour density 2.93 - (Air = 1.0)

10. STABILITY AND REACTIVITY

10.1 Reactivity
no data available

10.2 Chemical stability
Stable under recommended storage conditions.
Contains the following stabiliser(s):
2-Methyl-2-butene (>0.005 - <0.015 %)

10.3 Possibility of hazardous reactions
no data available

10.4 Conditions to avoid
Heat, flames and sparks. Exposure to sunlight.

10.5 Incompatible materials
Alkali metals, Aluminum, Strong oxidizing agents, Bases, Amines, Magnesium, Strong acids and strong bases, Vinyl compounds

10.6 Hazardous decomposition products
Other decomposition products - no data available
In the event of fire: see section 5

11. TOXICOLOGICAL INFORMATION

11.1 Information on toxicological effects

Acute toxicity
LD50 Oral - rat - > 2,000 mg/kg

LC50 Inhalation - rat - 52,000 mg/m3

LD50 Dermal - rat - > 2,000 mg/kg
(OECD Test Guideline 402)

no data available

Skin corrosion/irritation
Skin - rabbit
Result: Irritating to skin. - 24 h
(Draize Test)

Serious eye damage/eye irritation
Eyes - rabbit
Result: Irritating to eyes. - 24 h
(Draize Test)

Respiratory or skin sensitisation
no data available

Germ cell mutagenicity

rat
DNA damage

Carcinogenicity

Carcinogenicity - rat - Inhalation
Tumorigenic:Carcinogenic by RTECS criteria. Endocrine:Tumors.

Limited evidence of carcinogenicity in animal studies

Suspected human carcinogens

IARC: 2B - Group 2B: Possibly carcinogenic to humans (Methylene chloride)

NTP: Reasonably anticipated to be a human carcinogen (Methylene chloride)

OSHA: OSHA specifically regulated carcinogen (Methylene chloride)

Reproductive toxicity

no data available

Specific target organ toxicity - single exposure
May cause respiratory irritation.
May cause drowsiness or dizziness.

Specific target organ toxicity - repeated exposure
Inhalation - May cause damage to organs through prolonged or repeated exposure. - Central nervous system
Oral - May cause damage to organs through prolonged or repeated exposure. - Liver, Blood

Aspiration hazard
no data available

Additional Information
RTECS: PA8050000

Dichloromethane is metabolized in the body producing carbon monoxide which increases and sustains carboxyhemoglobin levels in the blood, reducing the oxygen-carrying capacity of the blood., Acts as a simple asphyxiant by displacing air., anesthetic effects, Difficulty in breathing, Headache, Dizziness, Prolonged or repeated contact with skin may cause:, defatting, Dermatitis, Contact with eyes can cause:, Redness, Blurred vision, Provokes tears., Effects due to ingestion may include:, Gastrointestinal discomfort, Central nervous system depression, Paresthesia., Drowsiness, Convulsions, Conjunctivitis., Pulmonary edema. Effects may be delayed., Irregular breathing., Stomach/intestinal disorders, Nausea, Vomiting, Increased liver enzymes., Weakness, Heavy or prolonged skin exposure may result in the absorption of harmful amounts of material., Abdominal pain

Stomach - Irregularities - Based on Human Evidence
Stomach - Irregularities - Based on Human Evidence

12. ECOLOGICAL INFORMATION

12.1 Toxicity

Toxicity to fish	LC50 - Pimephales promelas (fathead minnow) - 193.00 mg/l - 96 h
	NOEC - Cyprinodon variegatus (sheepshead minnow) - 130 mg/l - 96 h
Toxicity to daphnia and other aquatic invertebrates	EC50 - Daphnia magna (Water flea) - 1,682.00 mg/l - 48 h

12.2 Persistence and degradability
no data available

12.3 Bioaccumulative potential
no data available

12.4 Mobility in soil
no data available

12.5 Results of PBT and vPvB assessment
PBT/vPvB assessment not available as chemical safety assessment not required/not conducted

12.6 Other adverse effects

13. DISPOSAL CONSIDERATIONS

13.1 Waste treatment methods

Product
Offer surplus and non-recyclable solutions to a licensed disposal company. Contact a licensed professional waste disposal service to dispose of this material. Dissolve or mix the material with a combustible solvent and burn in a chemical incinerator equipped with an afterburner and scrubber.

Contaminated packaging
Dispose of as unused product.

14. TRANSPORT INFORMATION

DOT (US)
UN number: 1593 Class: 6.1 Packing group: III
Proper shipping name: Dichloromethane
Reportable Quantity (RQ): 1000 lbs
Marine pollutant: No
Poison Inhalation Hazard: No

IMDG
UN number: 1593 Class: 6.1 Packing group: III EMS-No: F-A, S-A
Proper shipping name: DICHLOROMETHANE
Marine pollutant: No

IATA
UN number: 1593 Class: 6.1 Packing group: III
Proper shipping name: Dichloromethane

15. REGULATORY INFORMATION

REACH No. : 01-2119480404-41-XXXX

SARA 302 Components
SARA 302: No chemicals in this material are subject to the reporting requirements of SARA Title III, Section 302.

SARA 313 Components
The following components are subject to reporting levels established by SARA Title III, Section 313:

	CAS-No.	Revision Date
Methylene chloride	75-09-2	2007-07-01

SARA 311/312 Hazards
Acute Health Hazard, Chronic Health Hazard

Massachusetts Right To Know Components

	CAS-No.	Revision Date
Methylene chloride	75-09-2	2007-07-01

Pennsylvania Right To Know Components

	CAS-No.	Revision Date
Methylene chloride	75-09-2	2007-07-01

New Jersey Right To Know Components

	CAS-No.	Revision Date
Methylene chloride	75-09-2	2007-07-01

California Prop. 65 Components

	CAS-No.	Revision Date
WARNING! This product contains a chemical known to the State of California to cause cancer. Methylene chloride	75-09-2	2007-09-28

16. OTHER INFORMATION

Full text of H-Statements referred to under sections 2 and 3.

Carc.	Carcinogenicity
Eye Irrit.	Eye irritation
H315	Causes skin irritation.
H319	Causes serious eye irritation.
H335	May cause respiratory irritation.
H336	May cause drowsiness or dizziness.
H351	Suspected of causing cancer.
H373	May cause damage to organs through prolonged or repeated exposure if swallowed.
Skin Irrit.	Skin irritation
STOT RE	Specific target organ toxicity - repeated exposure

STOT SE Specific target organ toxicity - single exposure

HMIS Rating

Health hazard:	2
Chronic Health Hazard:	*
Flammability:	0
Physical Hazard	0

NFPA Rating

Health hazard:	2
Fire Hazard:	0
Reactivity Hazard:	0

Further information

The above information is believed to be correct but does not purport to be all inclusive and shall be used only as a guide. The information in this document is based on the present state of our knowledge and is applicable to the product with regard to appropriate safety precautions. It does not represent any guarantee of the properties of the product. Sigma-Aldrich Corporation and its Affiliates shall not be held liable for any damage resulting from handling or from contact with the above product. See www.sigma-aldrich.com and/or the reverse side of invoice or packing slip for additional terms and conditions of sale.

Preparation Information

Sigma-Aldrich Corporation
Product Safety – Americas Region
1-800-521-8956

Version: 5.3 Revision Date: 02/20/2014 Print Date: 03/03/2014

9.7.Security data sheet Paraffin wax

ThermoFisher SCIENTIFIC

SAFETY DATA SHEET

Creation Date 04-Jun-2010 Revision Date 24-Jan-2018 Revision Number 4

1. Identification

Product Name: Paraffin wax

Cat No. : AC416770000; AC416770020; AC416770100

CAS-No: 8002-74-2

Synonyms: Paraffin wax (petroleum). It consists predominantly of straight chain hydrocarbons having carbon numbers predominantly greater than C20.

Recommended Use: Laboratory chemicals.

Uses advised against: Not for food, drug, pesticide or biocidal product use

Details of the supplier of the safety data sheet

Company

Fisher Scientific
One Reagent Lane
Fair Lawn, NJ 07410
Tel: (201) 796-7100

Acros Organics
One Reagent Lane
Fair Lawn, NJ 07410

Emergency Telephone Number
For information US call: 001-800-ACROS-01 / Europe call: +32 14 57 52 11
Emergency Number US:001-201-796-7100 / Europe: +32 14 57 52 99
CHEMTREC Tel. No.US:001-800-424-9300 / Europe:001-703-527-3887

2. Hazard(s) identification

Classification

Classification under 2012 OSHA Hazard Communication Standard (29 CFR 1910.1200)

Based on available data, the classification criteria are not met

Label Elements

None required

Hazards not otherwise classified (HNOC)

None identified

3. Composition/Information on Ingredients

Component	CAS-No	Weight %
Paraffin waxes and Hydrocarbon waxes	8002-74-2	>95

4. First-aid measures

Eye Contact	Rinse immediately with plenty of water, also under the eyelids, for at least 15 minutes. Get medical attention.
Skin Contact	Wash off immediately with soap and plenty of water. Obtain medical attention.
Inhalation	Remove from exposure, lie down. Move to fresh air. If not breathing, give artificial respiration. Obtain medical attention.
Ingestion	Do not induce vomiting. Never give anything by mouth to an unconscious person. Drink plenty of water. Get medical attention. If possible drink milk afterwards.
Most important symptoms and effects	No information available.
Notes to Physician	Treat symptomatically

5. Fire-fighting measures

Suitable Extinguishing Media	Water spray. Carbon dioxide (CO_2). Dry chemical. Chemical foam.
Unsuitable Extinguishing Media	No information available
Flash Point	198 °C / 388.4 °F
Method -	No information available
Autoignition Temperature	245 °C / 473 °F
Explosion Limits	
Upper	No data available
Lower	No data available
Sensitivity to Mechanical Impact	No information available
Sensitivity to Static Discharge	No information available

Specific Hazards Arising from the Chemical
Keep product and empty container away from heat and sources of ignition.

Hazardous Combustion Products
Carbon monoxide (CO) Carbon dioxide (CO_2)
Protective Equipment and Precautions for Firefighters
As in any fire, wear self-contained breathing apparatus pressure-demand, MSHA/NIOSH (approved or equivalent) and full protective gear.

NFPA

Health	Flammability	Instability	Physical hazards
0	1	0	N/A

6. Accidental release measures

Personal Precautions	Ensure adequate ventilation. Use personal protective equipment.
Environmental Precautions	See Section 12 for additional ecological information.

Methods for Containment and Clean Up: Sweep up or vacuum up spillage and collect in suitable container for disposal.

7. Handling and storage

Handling	Avoid contact with skin and eyes. Do not breathe dust.
Storage	Keep containers tightly closed in a dry, cool and well-ventilated place.

8. Exposure controls / personal protection

Exposure Guidelines

Component	ACGIH TLV	OSHA PEL	NIOSH IDLH	Mexico OEL (TWA)
Paraffin waxes and Hydrocarbon waxes	TWA: 2 mg/m³	(Vacated) TWA: 2 mg/m³	TWA: 2 mg/m³	TWA: 2 mg/m³ STEL: 6 mg/m³

Legend

ACGIH - American Conference of Governmental Industrial Hygienists
OSHA - Occupational Safety and Health Administration
NIOSH IDLH: The National Institute for Occupational Safety and Health Immediately Dangerous to Life or Health

Engineering Measures: None under normal use conditions.

Personal Protective Equipment

Eye/face Protection: Wear appropriate protective eyeglasses or chemical safety goggles as described by OSHA's eye and face protection regulations in 29 CFR 1910.133 or European Standard EN166.

Skin and body protection: Wear appropriate protective gloves and clothing to prevent skin exposure.

Respiratory Protection: No protective equipment is needed under normal use conditions.

Hygiene Measures: Handle in accordance with good industrial hygiene and safety practice.

9. Physical and chemical properties

Physical State	Solid
Appearance	White
Odor	Odorless
Odor Threshold	No information available
pH	No information available
Melting Point/Range	58 - 62 °C / 136.4 - 143.6 °F
Boiling Point/Range	322 °C / 611.6 °F @ 760 mmHg
Flash Point	198 °C / 388.4 °F
Evaporation Rate	Not applicable
Flammability (solid,gas)	No information available
Flammability or explosive limits	
Upper	No data available
Lower	No data available
Vapor Pressure	No information available
Vapor Density	Not applicable
Specific Gravity	No information available
Solubility	Insoluble in water
Partition coefficient; n-octanol/water	No data available
Autoignition Temperature	245 °C / 473 °F
Decomposition Temperature	No information available
Viscosity	Not applicable

10. Stability and reactivity

Reactive Hazard: None known, based on information available

Stability: Stable under normal conditions.

Conditions to Avoid: Incompatible products.

Incompatible Materials: Strong oxidizing agents

Hazardous Decomposition Products Carbon monoxide (CO), Carbon dioxide (CO_2)

Hazardous Polymerization Hazardous polymerization does not occur.

Hazardous Reactions None under normal processing.

11. Toxicological information

Acute Toxicity

Product Information

Component Information

Component	LD50 Oral	LD50 Dermal	LC50 Inhalation
Paraffin waxes and Hydrocarbon waxes	LD50 > 5000 mg/kg (Rat)	LD50 > 3600 mg/kg (Rabbit)	Not listed

Toxicologically Synergistic Products No information available

Delayed and immediate effects as well as chronic effects from short and long-term exposure

Irritation No information available

Sensitization No information available

Carcinogenicity The table below indicates whether each agency has listed any ingredient as a carcinogen.

Component	CAS-No	IARC	NTP	ACGIH	OSHA	Mexico
Paraffin waxes and Hydrocarbon waxes	8002-74-2	Not listed	Not listed	Not listed	Not listed	Not listed

Mutagenic Effects No information available

Reproductive Effects No information available.

Developmental Effects No information available.

Teratogenicity No information available.

STOT - single exposure None known

STOT - repeated exposure None known

Aspiration hazard No information available

Symptoms / effects,both acute and delayed No information available

Endocrine Disruptor Information No information available

Other Adverse Effects The toxicological properties have not been fully investigated.

12. Ecological information

Ecotoxicity

Persistence and Degradability Insoluble in water

Bioaccumulation/ Accumulation No information available.

Mobility Is not likely mobile in the environment due its low water solubility.

13. Disposal considerations

Waste Disposal Methods: Chemical waste generators must determine whether a discarded chemical is classified as a hazardous waste. Chemical waste generators must also consult local, regional, and national hazardous waste regulations to ensure complete and accurate classification.

14. Transport information

DOT: Not regulated
TDG: Not regulated
IATA: Not regulated
IMDG/IMO: Not regulated

15. Regulatory information

All of the components in the product are on the following Inventory lists: X = listed

International Inventories

Component	TSCA	DSL	NDSL	EINECS	ELINCS	NLP	PICCS	ENCS	AICS	IECSC	KECL
Paraffin waxes and Hydrocarbon waxes	X	X	-	232-315-6	-		X	X	X	X	X

Legend:
X - Listed
E - Indicates a substance that is the subject of a Section 5(e) Consent order under TSCA.
F - Indicates a substance that is the subject of a Section 5(f) Rule under TSCA.
N - Indicates a polymeric substance containing no free-radical initiator in its inventory name but is considered to cover the designated polymer made with any free-radical initiator regardless of the amount used.
P - Indicates a commenced PMN substance
R - Indicates a substance that is the subject of a Section 6 risk management rule under TSCA.
S - Indicates a substance that is identified in a proposed or final Significant New Use Rule
T - Indicates a substance that is the subject of a Section 4 test rule under TSCA.
XU - Indicates a substance exempt from reporting under the Inventory Update Rule, i.e. Partial Updating of the TSCA Inventory Data Base Production and Site Reports (40 CFR 710(B).
Y1 - Indicates an exempt polymer that has a number-average molecular weight of 1,000 or greater.
Y2 - Indicates an exempt polymer that is a polyester and is made only from reactants included in a specified list of low concern reactants that comprises one of the eligibility criteria for the exemption rule.

U.S. Federal Regulations

TSCA 12(b): Not applicable

SARA 313: Not applicable

SARA 311/312 Hazard Categories: See section 2 for more information

CWA (Clean Water Act): Not applicable

Clean Air Act: Not applicable

OSHA Occupational Safety and Health Administration
Not applicable

CERCLA: Not applicable

California Proposition 65: This product does not contain any Proposition 65 chemicals

U.S. State Right-to-Know Regulations

Component	Massachusetts	New Jersey	Pennsylvania	Illinois	Rhode Island
Paraffin waxes and Hydrocarbon waxes	X	X	X	-	X

U.S. Department of Transportation

Reportable Quantity (RQ):	N
DOT Marine Pollutant	N
DOT Severe Marine Pollutant	N

U.S. Department of Homeland Security
This product does not contain any DHS chemicals.

Other International Regulations

Mexico - Grade No information available

16. Other information

Prepared By	Regulatory Affairs Thermo Fisher Scientific Email: EMSDS.RA@thermofisher.com
Creation Date	04-Jun-2010
Revision Date	24-Jan-2018
Print Date	24-Jan-2018
Revision Summary	This document has been updated to comply with the US OSHA HazCom 2012 Standard replacing the current legislation under 29 CFR 1910.1200 to align with the Globally Harmonized System of Classification and Labeling of Chemicals (GHS).

Disclaimer
The information provided in this Safety Data Sheet is correct to the best of our knowledge, information and belief at the date of its publication. The information given is designed only as a guidance for safe handling, use, processing, storage, transportation, disposal and release and is not to be considered a warranty or quality specification. The information relates only to the specific material designated and may not be valid for such material used in combination with any other materials or in any process, unless specified in the text

End of SDS

9.8.Poly(lactic-*co*-glycolic acid)

SAFETY DATA SHEET

according to Regulation (EC) No. 1907/2006
Version 1.0 Revision Date 02.13.2013

1. IDENTIFICATION OF THE SUBSTANCE/MIXTURE AND OF THE COMPANY/UNDERTAKING

Product name	:	POLY(D,L-LACTIC-co-GLYCOLIC ACID) **Product from R&D - For R&D use only**
Product Number	:	
Company	:	SPECIFIC POLYMERS Zac Via Domitia - 150 Avenue des Cocardières F-34160 Castries - France
Telephone	:	+33(0)499749135
Fax	:	+33(0)499749152
Emergency Phone #	:	I.N.R.S.:+33 (0)1 45 42 59 59
E-mail address	:	cedric.loubat@specificpolymers.fr

2. HAZARDS IDENTIFICATION

Classification of the substance or mixture

Label elements

Pictogram none
Signal word none

Hazard statement(s)

Not a dangerous substance according to CLP - GHS.
This substance is not classified as dangerous according to Directive 67/548/EEC And CE 1272/2008.

Caution - substance not yet tested completely

Precautionary statement(s)

none

Other hazards - none

3. COMPOSITION/INFORMATION ON INGREDIENTS

CAS-No.	EINECS	Index-No.	Classification	Concentration
26780-50-7			Not dangerous	

For the full text of the H-Statements mentioned in this Section, see Section 16.

4. FIRST AID MEASURES

General advice
Consult a physician. Show this safety data sheet to the doctor in attendance.

If inhaled
If breathed in, move person into fresh air. If not breathing, give artificial respiration. Consult a physician.

In case of skin contact
Wash off with soap and plenty of water. Consult a physician.

In case of eye contact
Rinse thoroughly with plenty of water for at least 15 minutes and consult a physician.

If swallowed
Never give anything by mouth to an unconscious person. Rinse mouth with water. Consult a physician.

5. FIRE-FIGHTING MEASURES

Suitable extinguishing media
Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide.

Special protective equipment for fire-fighters
Wear self contained breathing apparatus for fire fighting if necessary.

6. ACCIDENTAL RELEASE MEASURES

Personal precautions
Use personal protective equipment. Avoid dust formation. Avoid breathing vapors, mist or gas. Ensure adequate ventilation. Evacuate personnel to safe areas. Avoid breathing dust.

Environmental precautions
Do not let product enter drains.

Methods and materials for containment and cleaning up
Pick up and arrange disposal without creating dust. Sweep up and shovel. Keep in suitable, closed containers for disposal.

7. HANDLING AND STORAGE

Precautions for safe handling
Avoid formation of dust and aerosols.
Provide appropriate exhaust ventilation at places where dust is formed. Normal measures for preventive fire protection.

Conditions for safe storage
Keep container tightly closed in a dry and well-ventilated place. Store in cool place.

Store under inert gas. Moisture sensitive.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Personal protective equipment

Respiratory protection
Where risk assessment shows air-purifying respirators are appropriate use a full-face particle respirator type N100 (US) or type P3 (EN 143) respirator cartridges as a backup to engineering controls. If the respirator is the sole means of protection, use a full-face supplied air respirator. Use respirators and components tested and approved under appropriate government standards such as NIOSH (US) or CEN (EU).

Hand protection
Handle with gloves. Gloves must be inspected prior to use. Use proper glove removal technique (without touching glove's outer surface) to avoid skin contact with this product. Dispose of contaminated gloves after use in accordance with applicable laws and good laboratory practices. Wash and dry hands.

The selected protective gloves have to satisfy the specifications of EU Directive 89/686/EEC and the standard EN 374 derived from it.

Eye protection
Face shield and safety glasses Use equipment for eye protection tested and approved under appropriate government standards such as NIOSH (US) or EN 166(EU).

Skin and body protection
Complete suit protecting against chemicals, The type of protective equipment must be selected according to the concentration and amount of the dangerous substance at the specific workplace.

Hygiene measures
Handle in accordance with good industrial hygiene and safety practice. Wash hands before breaks and at the end of workday.

9. PHYSICAL AND CHEMICAL PROPERTIES

Appearance

Form	solid

Safety data

pH	no data available
Melting point	no data available
Boiling point	no data available
Flash point	no data available
Ignition temperature	no data available
Lower explosion limit	no data available
Upper explosion limit	no data available
Water solubility	no data available
Inflammability	no data available

10. STABILITY AND REACTIVITY

Chemical stability
Stable under recommended storage conditions.

Conditions to avoid
no data available

Materials to avoid
Strong oxidizing agents

Hazardous decomposition products
Hazardous decomposition products formed under fire conditions. - Carbon oxides,

11. TOXICOLOGICAL INFORMATION

Acute toxicity
no data available

Skin corrosion/irritation
no data available

Serious eye damage/eye irritation
no data available

Respiratory or skin sensitization
no data available

Germ cell mutagenicity
no data available

Carcinogenicity

IARC: No component of this product present at levels greater than or equal to 0.1% is identified as probable, possible or confirmed human carcinogen by IARC.

Reproductive toxicity
no data available

Specific target organ toxicity - single exposure
no data available

Specific target organ toxicity - repeated exposure
no data available

Aspiration hazard
no data available

Potential health effects

Inhalation	May be harmful if inhaled. May cause respiratory tract irritation.
Ingestion	May be harmful if swallowed.
Skin	May be harmful if absorbed through skin. May cause skin irritation.
Eyes	Causes eye burns.

Signs and Symptoms of Exposure
To the best of our knowledge, the chemical, physical, and toxicological properties have not been thoroughly investigated.

Additional Information
RTECS: Not available

12. ECOLOGICAL INFORMATION

Toxicity

no data available

Persistence and degradability
no data available

Bioaccumulative potential
no data available

Mobility in soil
no data available

PBT and vPvB assessment
no data available

Other adverse effects
no data available

13. DISPOSAL CONSIDERATIONS

Product
Offer surplus and non-recyclable solutions to a licensed disposal company. Contact a licensed professional waste disposal service to dispose of this material. Dissolve or mix the material with a combustible solvent and burn in a chemical incinerator equipped with an afterburner and scrubber.

Contaminated packaging
Dispose of as unused product.

14. TRANSPORT INFORMATION

ADR/RID
Not dangerous goods

IMDG
Not dangerous goods

IATA
Not dangerous goods

15. REGULATORY INFORMATION

This safety datasheet complies with the requirements of Regulation (EC) No. 1907/2006.

16. OTHER INFORMATION

Text of H-code(s) and R-phrase(s) mentioned in Section 3

none

Further information

The above information is believed to be correct but does not purport to be all inclusive and shall be used only as a guide. The information in this document is based on the present state of our knowledge and is applicable to the product with regard to appropriate safety precautions. It does not represent any guarantee of the properties of the product. Specific Polymers, shall not be held liable for any damage resulting from handling or from contact with the above product. See reverse side of invoice or packing slip for additional terms and conditions of sale. The product is solely research and development purpose and not intended for food, drug or household purposes.

9.9. Polylactide

NETCO EXTRUDED PLASTICS

Safety Data Sheet
Polylactide (PLA)

Material Safety Data Sheet

In accordance with 29 CFR 1910.1200, ANSI Z400.1-2004, and ISO 11014-1: 1994.

1. IDENTIFICATION OF THE SUBSTANCE/PREPARATION AND THE COMPANY/UNDERTAKING

Product name: Polylactide PLA R17009A
Product Use: for extrusion and molding applications
Supplier: Netco Extruded Plastics Inc. 30 Tower Street Hudson, MA 01028
Emergency telephone numbers (24 hours a day): (978) 562-3485 or 1(800)-638-2621

2. HAZARDS IDENTIFICATION

Emergency Overview
CAUTION! May cause eye/skin irritation. Burning produces obnoxious and toxic fumes. Avoid contact with skin and eyes. Avoid formation of dust and aerosols.
Appearance: Clear, translucent, or opaque strand/string.
Color: Varies
Physical state: Solid
Odor: Sweet
Potential health effects: Eye contact: Contact with eyes may cause irritation.
Skin contact: Substance may cause slight skin irritation.
Ingestion: Ingestion may cause gastrointestinal irritation, nausea, vomiting and diarrhea.
Inhalation: Inhalation of dust may cause shortness of breath, tightness of the chest, a sore throat and cough. Low hazard for usual handling.
Target organ effects: N/A
Sensitization: N/A
Specific hazards: No information available
Flammability: Fine dust dispersed in air may ignite.
Environmental precautions: Not determined See Section 12 for more information.
NFPA rating: Data not available
Health: 1
Flammability: 1
Reactivity: 0
Special: Not determined
HMIS classification:
Health: 1
Flammability: 1
Reactivity: 0
Personal Protective Equipment: Not determined

NETCO EXTRUDED PLASTICS

Safety Data Sheet
Polylactide (PLA)

3. COMPOSITION/INFORMATION ON INGREDIENTS

Chemical name: Polylactide resin 9051-89-2
Weight %: >98
OSHA Exposure Limits: None
ACGIH Exposure Limits: None
All ingredients in quantities > 1.0% (0.1% for carcinogens) that are potentially hazardous per OSHA definitions.
Other Standards: N/A

4. FIRST AID MEASURES

Emergency telephone numbers (24 hours a day): (978) 562-3485 or 1(800)-638-2621
Eye contact: Rinse immediately with plenty of water, also under the eyelids, for at least 15 minutes. Call a physician immediately.
Skin contact: Rinse immediately with plenty of water for at least 15 minutes. If skin irritation persists, call a physician. Cool skin rapidly with cold water after contact with hot polymer.
Inhalation: Move to fresh air. Call a physician immediately.
Ingestion: Drink water as a precaution. Never give anything by mouth to an unconscious person. Do not induce vomiting without medical advice. Call a physician immediately.
Notes to physician: Treat symptomatically.

5. FIRE FIGHTING MEASURES

Flammability:
Auto ignition temperature: 388C
Flammability Limits in Air:
Flammable limits in air - lower (%): Not applicable
Flammable limits in air - upper (%): Not applicable
Suitable extinguishing media: Foam. Water. Carbon dioxide (CO2). Dry chemical. Alcohol resistant foams are preferred if available. General-purpose synthetic foams (including AFFF) or protein foams may function, but much less effectively.
Extinguishing media which must not be used for safety reasons: No information available
Hazardous decomposition products: Burning produces obnoxious and toxic fumes Aldehydes Carbon monoxide (CO) carbon dioxide (CO2)
Special protective equipment for firefighters: As in any fire, wear self-contained breathing apparatus pressure-demand, MSHA/NIOSH (approved or equivalent) and full protective gear.
Under fire conditions: Cool containers / tanks with spray water. Water mist may be used to cool closed containers.
Other information: Fine dust dispersed in air may ignite. Risks of ignition followed by flame propagation or secondary explosions shall be prevented by avoiding accumulation of dust, e.g. on floors and ledges.

NETCO EXTRUDED PLASTICS

Safety Data Sheet
Polylactide (PLA)

6. ACCIDENTAL RELEASE MEASURES

Personal precautions: Use personal protective equipment. See Section 8. Remove all sources of ignition. Avoid contact with skin and eyes. Sweep up to prevent slipping hazard.
Environmental precautions: Do not flush into surface water or sanitary sewer system. Do not allow material to contaminate ground water system.
Methods for cleaning up: Place into suitable container for disposal.

7. HANDLING AND STORAGE

Safe handling advice: Avoid contact with skin and eyes. Avoid dust formation. Workers should be protected from the possibility of contact with molten material during fabrication. Low hazard for usual industrial or commercial handling. Use personal protective equipment. See Section 8.
Storage: Store in cool place. Keep at temperatures below 122F (50 °C). No special restrictions on storage with other products
Precautions: No special precautions required

8. EXPOSURE CONTROLS / PERSONAL PROTECTION

Engineering measures: Where reasonably practicable this should be achieved by the use of local exhaust ventilation and good general extraction.
Control parameters: None
PERSONAL PROTECTIVE EQUIPMENT:
Eye protection: Safety glasses with side-shields. Goggles.
Skin and body protection: Impervious clothing.
Respiratory protection: Respirator must be worn if exposed to dust. Wear respirator with dust filter. Respiratory protection is needed if any of the exposure limits in Section 2 are exceeded. Consult an industrial hygiene professional prior to respirator selection and use. Use a positive-pressure air supplied respirator if there is any potential for an uncontrolled release, exposure levels are not known, or any other circumstances where air purifying respirators may not provide adequate protection. WARNING: Air purifying respirators do not protect workers in oxygendeficient atmospheres.
Hand protection: Preventive skin protection.
Hygiene measures: Avoid contact with skin, eyes and clothing.
Exposure limits: See Section 2.

9. PHYSICAL AND CHEMICAL PROPERTIES:

Appearance: Clear, translucent, opaque, strand/string.
Color: Varies
Physical state: Solid
Odor: Sweet
pH: Not applicable

Vapor pressure: Not determined
Vapor density: Not determined
Evaporation rate: Not determined
Density: 1.24 g/cc
Boiling point/range: Not applicable
Decomposition temperature: 482F (250C)
Melting point/range: Not determined
Water solubility: Insoluble
Solubility in other solvents: None known

10. STABILITY AND REACTIVITY

Stability: Stable under recommended storage conditions
Conditions to avoid: Temperatures above 446F (230 °C).
Materials to avoid: Oxidizing agents. Strong bases.
Hazardous decomposition products: Burning produces obnoxious and toxic fumes. Aldehydes. Carbon monoxide (CO). Carbon dioxide (CO2).
Polymerization: Not applicable

11. TOXICOLOGICAL INFORMATION

Principle Routes of Exposure: Eye contact. Skin contact. Inhalation. Ingestion.
Acute toxicity: N/A
Local effects: May cause eye/skin irritation. Product dust may be irritating to eyes, skin and respiratory system. Caused mild to moderate conjunctival irritation in eye irritation studies using rabbits. Caused very mild redness in dermal irritation studies using rabbits (slightly irritating). Ingestion may cause gastrointestinal irritation, nausea, vomiting and diarrhea.
Long term toxicity: Did not cause skin allergic reactions in skin sensitization studies using guinea pigs.
Specific effects: May cause skin irritation and/or dermatitis. Ingestion may cause gastrointestinal irritation, nausea, vomiting and diarrhea. Inhalation of dust may cause shortness of breath, tightness of the chest, a sore throat and cough. Burning produces irritant fumes.
Mutagenic effects: Not mutagenic in AMES Test.

12. TOXICOLOGICAL INFORMATION

Reproductive toxicity: No data is available on the product itself.
Carcinogenic effects: No data is available on the product itself.
Target organ effects: There were no target organ effects noted following ingestion or dermal exposure in animal studies.
Skin: LD50/dermal/rabbit > 2000 mg/kg
Ingestion: LD50/oral/rat > 5000 mg/kg.

NETCO EXTRUDED PLASTICS

Safety Data Sheet
Polylactide (PLA)

13. ECOLOGICAL INFORMATION

Mobility: No data available
Bioaccumulation: Does not bio accumulate. Inherently biodegradable.
Ecotoxicity effects: EC50/72h/algae > 1100 mg/L

14. DISPOSAL CONSIDERATIONS

Waste from residues / unused products: In accordance with local and national regulations. Do not contaminate ponds, waterways or ditches with chemical or used container. Contact manufacturer. THE COMPANY HAS NO CONTROL OVER THE MANAGEMENT PRACTICES OR MANUFACTURING PROCESSES OF PARTIES HANDLING OR USING THIS MATERIAL. THE INFORMATION PRESENTED HERE PERTAINS ONLY TO THE PRODUCT AS SHIPPED IN ITS INTENDED CONDITION AS DESCRIBED IN MSDS SECTION 2 (Composition/Information On Ingredients).
Contaminated packaging: Empty remaining contents. Do not re-use empty containers. Empty containers should be transported/delivered using a registered waste carrier to local recyclers for disposal.

15. TRANSPORT INFORMATION

U.S. Department of Transportation (DOT):
Proper shipping name: Not regulated as a hazardous material.
IMDG:
Proper shipping name: None
Hazard class: Not regulated.
UN/Id No.: None
Packing group: None
ICAO/IATA:
Proper shipping name: None
Hazard Class: Not regulated.
Packing group: None

16. REGULATORY INFORMATION

(Not meant to be all inclusive--selected regulations represented) NOTICE: The information herein is presented in good faith and believed to be accurate as of the print date shown above. However, no warranty, express or implied is given. Regulatory requirements are subject to change and may differ from one location to another; it is the buyer's responsibility to ensure that its activities comply with federal, state or provincial, and local laws. The following specific information is made for the purpose of complying with numerous federal, state or provincial, and local laws and regulations. See other sections for health and safety information.
U.S. REGULATIONS

Sara 313 title III: Not listed TSCA Inventory List – Not listed

STATE REGULATIONS

California Proposition 65 Not listed

INTERNATIONAL INVENTORIES

Canada DSL Inventory List : Not listed

REACH/EU EINECS List : Components are in compliance with and/or are listed.

Japan (ECL) : Not listed

Australia (AICS): Not listed

Korean chemical inventory: Not listed

Philippines (PICCS) inventory: Not listed

China inventory of existing chemical substances list : No listed

17. OTHER INFORMATION

Product name: Polylactide PLA R17009A

Reason for revision: Created Revision date: 06/23/2016

Recommended restrictions: None

Prepared by: Netco Extruded Plastics Inc.

The Information Herein Is Given In Good Faith, But No Warranty, Express Or Implied, Is Made. Consult the Company for Further Information.

NOTICE: The information contained herein is provided by the suppliers of our raw materials. While NETCO believes the information contained herin is accurate, NETCO Extruded Plastics, Inc. makes no warranty, express or implied, with respect to this information and expressly disclaims all liability for reliance thereon. This data is offered for your consideration, investigation and verification.

NOTICE REGARDING MEDICAL APPLICATION RESTRICTIONS: The company does not recommend any of its products, including samples, for use: (A) in any application which is intended for any internal contact with human body fluids or body tissues (B) as a critical component in any medical device that supports or sustains human life; and (C) specifically pregnant women or in any applications designed specifically to promote or interfere with human reproduction.

9.10. Security data sheet Poly(vinyl alcohol)

ThermoFisher SCIENTIFIC

SAFETY DATA SHEET

Creation Date 14-Mar-2013 Revision Date 19-Jan-2018 Revision Number 4

1. Identification

Product Name	Poly(vinyl alcohol), 95.5-96.5% hydrolyzed, average M.W. approx. 85000-124000
Cat No. :	AC183390000; AC183390010; AC183390025; AC183391000
Synonyms	No information available
Recommended Use	Laboratory chemicals.
Uses advised against	Not for food, drug, pesticide or biocidal product use

Details of the supplier of the safety data sheet

Company
Fisher Scientific
One Reagent Lane
Fair Lawn, NJ 07410
Tel: (201) 796-7100

Acros Organics
One Reagent Lane
Fair Lawn, NJ 07410

Emergency Telephone Number
For information US call: 001-800-ACROS-01 / Europe call: +32 14 57 52 11
Emergency Number US:001-201-796-7100 / Europe: +32 14 57 52 99
CHEMTREC Tel. No.US:001-800-424-9300 / Europe:001-703-527-3887

2. Hazard(s) identification

Classification
Classification under 2012 OSHA Hazard Communication Standard (29 CFR 1910.1200)

Based on available data, the classification criteria are not met

Label Elements
None required

Hazards not otherwise classified (HNOC)
None identified

3. Composition/Information on Ingredients

Component	CAS-No	Weight %
Polyvinyl alcohol	9002-89-5	>95

4. First-aid measures

Eye Contact	Rinse immediately with plenty of water, also under the eyelids, for at least 15 minutes. Get medical attention.
Skin Contact	Obtain medical attention. Wash off immediately with plenty of water for at least 15 minutes.
Inhalation	Move to fresh air. Obtain medical attention. If not breathing, give artificial respiration.
Ingestion	Do not induce vomiting. Obtain medical attention.
Most important symptoms and effects	No information available.
Notes to Physician	Treat symptomatically

5. Fire-fighting measures

Suitable Extinguishing Media	Water spray. Carbon dioxide (CO_2). Dry chemical. Chemical foam.
Unsuitable Extinguishing Media	No information available
Flash Point	No information available
Method -	No information available
Autoignition Temperature	No information available
Explosion Limits	
Upper	No data available
Lower	No data available
Sensitivity to Mechanical Impact	No information available
Sensitivity to Static Discharge	No information available

Specific Hazards Arising from the Chemical
Keep product and empty container away from heat and sources of ignition. Thermal decomposition can lead to release of irritating gases and vapors.

Hazardous Combustion Products
Carbon monoxide (CO) Carbon dioxide (CO_2)
Protective Equipment and Precautions for Firefighters
As in any fire, wear self-contained breathing apparatus pressure-demand, MSHA/NIOSH (approved or equivalent) and full protective gear.

NFPA

Health	Flammability	Instability	Physical hazards
1	1	0	N/A

6. Accidental release measures

Personal Precautions	Use personal protective equipment. Ensure adequate ventilation. Avoid contact with the skin and the eyes. Avoid dust formation.
Environmental Precautions	See Section 12 for additional ecological information.
Methods for Containment and Clean Up	Sweep up or vacuum up spillage and collect in suitable container for disposal. Avoid dust formation.

7. Handling and storage

Handling	Avoid contact with skin and eyes. Do not breathe dust. Ensure adequate ventilation. Wear personal protective equipment. Avoid dust formation.
Storage	Keep in a dry, cool and well-ventilated place. Keep container tightly closed.

8. Exposure controls / personal protection

Exposure Guidelines

Engineering Measures	None under normal use conditions.

Personal Protective Equipment

Eye/face Protection	Wear appropriate protective eyeglasses or chemical safety goggles as described by OSHA's eye and face protection regulations in 29 CFR 1910.133 or European Standard EN166.
Skin and body protection	Wear appropriate protective gloves and clothing to prevent skin exposure.
Respiratory Protection	No protective equipment is needed under normal use conditions.
Hygiene Measures	Handle in accordance with good industrial hygiene and safety practice.

9. Physical and chemical properties

Physical State	Solid
Appearance	Off-white
Odor	No information available
Odor Threshold	No information available
pH	4.5-6.5 @ 20°C 40 g/l water
Melting Point/Range	230 - 240 °C / 446 - 464 °F
Boiling Point/Range	No information available
Flash Point	No information available
Evaporation Rate	Not applicable
Flammability (solid,gas)	No information available
Flammability or explosive limits	
Upper	No data available
Lower	No data available
Vapor Pressure	No information available
Vapor Density	Not applicable
Specific Gravity	No information available
Solubility	No information available
Partition coefficient; n-octanol/water	No data available
Autoignition Temperature	No information available
Decomposition Temperature	No information available
Viscosity	Not applicable

10. Stability and reactivity

Reactive Hazard	None known, based on information available
Stability	Stable under normal conditions.
Conditions to Avoid	Heat, flames and sparks. Incompatible products.
Incompatible Materials	Acids, Bases, Strong oxidizing agents, sodium hypochlorite, Powdered metals
Hazardous Decomposition Products	Carbon monoxide (CO), Carbon dioxide (CO_2)
Hazardous Polymerization	Hazardous polymerization does not occur.
Hazardous Reactions	None under normal processing.

11. Toxicological information

Acute Toxicity

Product Information

Oral LD50 Based on ATE data, the classification criteria are not met. ATE > 2000 mg/kg.

Dermal LD50 Based on ATE data, the classification criteria are not met. ATE > 2000 mg/kg.

Mist LC50 Based on ATE data, the classification criteria are not met. ATE > 5 mg/l.

Component Information

Component	LD50 Oral	LD50 Dermal	LC50 Inhalation
Polyvinyl alcohol	> 5000 mg/kg (rat)	>7490 mg/kg (rabbit)	>20 mg/m³/h (rat)

Toxicologically Synergistic Products: No information available

Delayed and immediate effects as well as chronic effects from short and long-term exposure

Irritation: No information available

Sensitization: No information available

Carcinogenicity: The table below indicates whether each agency has listed any ingredient as a carcinogen.

Component	CAS-No	IARC	NTP	ACGIH	OSHA	Mexico
Polyvinyl alcohol	9002-89-5	Not listed	Not listed	Not listed	Not listed	Not listed

Mutagenic Effects: No information available

Reproductive Effects: No information available.

Developmental Effects: No information available.

Teratogenicity: No information available.

STOT - single exposure: None known

STOT - repeated exposure: None known

Aspiration hazard: No information available

Symptoms / effects,both acute and delayed: No information available

Endocrine Disruptor Information: No information available

Other Adverse Effects: The toxicological properties have not been fully investigated.

12. Ecological information

Ecotoxicity

Component	Freshwater Algae	Freshwater Fish	Microtox	Water Flea
Polyvinyl alcohol	Not listed	Lepomis macrochirus: LC50=10mg/L 96h	Not listed	EC50=8.3 mg/L 48h

Persistence and Degradability: Soluble in water Persistence is unlikely based on information available.

Bioaccumulation/ Accumulation: No information available.

Mobility: Will likely be mobile in the environment due to its water solubility.

13. Disposal considerations

Waste Disposal Methods: Chemical waste generators must determine whether a discarded chemical is classified as a hazardous waste. Chemical waste generators must also consult local, regional, and

national hazardous waste regulations to ensure complete and accurate classification.

14. Transport information

DOT	Not regulated
TDG	Not regulated
IATA	Not regulated
IMDG/IMO	Not regulated

15. Regulatory information

International Inventories

Component	TSCA	DSL	NDSL	EINECS	ELINCS	NLP	PICCS	ENCS	AICS	IECSC	KECL
Polyvinyl alcohol	X	X	-	-	-		X	X	X	X	X

Legend:
X - Listed
E - Indicates a substance that is the subject of a Section 5(e) Consent order under TSCA.
F - Indicates a substance that is the subject of a Section 5(f) Rule under TSCA.
N - Indicates a polymeric substance containing no free-radical initiator in its inventory name but is considered to cover the designated polymer made with any free-radical initiator regardless of the amount used.
P - Indicates a commenced PMN substance
R - Indicates a substance that is the subject of a Section 6 risk management rule under TSCA.
S - Indicates a substance that is identified in a proposed or final Significant New Use Rule
T - Indicates a substance that is the subject of a Section 4 test rule under TSCA.
XU - Indicates a substance exempt from reporting under the Inventory Update Rule, i.e. Partial Updating of the TSCA Inventory Data Base Production and Site Reports (40 CFR 710(B).
Y1 - Indicates an exempt polymer that has a number-average molecular weight of 1,000 or greater.
Y2 - Indicates an exempt polymer that is a polyester and is made only from reactants included in a specified list of low concern reactants that comprises one of the eligibility criteria for the exemption rule.

U.S. Federal Regulations

TSCA 12(b)	Not applicable
SARA 313	Not applicable
SARA 311/312 Hazard Categories	See section 2 for more information
CWA (Clean Water Act)	Not applicable
Clean Air Act	Not applicable

OSHA Occupational Safety and Health Administration
Not applicable

CERCLA	Not applicable
California Proposition 65	This product does not contain any Proposition 65 chemicals
U.S. State Right-to-Know Regulations	Not applicable

U.S. Department of Transportation

Reportable Quantity (RQ):	N
DOT Marine Pollutant	N
DOT Severe Marine Pollutant	N

U.S. Department of Homeland Security
This product does not contain any DHS chemicals.

Other International Regulations

Mexico - Grade	No information available

16. Other information

Prepared By	Regulatory Affairs Thermo Fisher Scientific Email: EMSDS.RA@thermofisher.com
Creation Date	14-Mar-2013
Revision Date	19-Jan-2018
Print Date	19-Jan-2018
Revision Summary	This document has been updated to comply with the US OSHA HazCom 2012 Standard replacing the current legislation under 29 CFR 1910.1200 to align with the Globally Harmonized System of Classification and Labeling of Chemicals (GHS).

Disclaimer
The information provided in this Safety Data Sheet is correct to the best of our knowledge, information and belief at the date of its publication. The information given is designed only as a guidance for safe handling, use, processing, storage, transportation, disposal and release and is not to be considered a warranty or quality specification. The information relates only to the specific material designated and may not be valid for such material used in combination with any other materials or in any process, unless specified in the text

End of SDS

9.11. Security data sheet

Material Safety Data Sheet
Styrene/maleic Anhydride Copolymer

ACC# 96797

Section 1 - Chemical Product and Company Identification

MSDS Name: Styrene/maleic Anhydride Copolymer
Catalog Numbers: AC179250000, AC179250050, AC179252500, AC190910000, AC190912500
Synonyms: Polymer with Ethylbenzene; Maleic Anhydride Styrene Polymer.
Company Identification:
Acros Organics N.V.
One Reagent Lane
Fair Lawn, NJ 07410
For information in North America, call: 800-ACROS-01
For emergencies in the US, call CHEMTREC: 800-424-9300

Section 2 - Composition, Information on Ingredients

CAS#	Chemical Name	Percent	EINECS/ELINCS
9011-13-6	Styrene/maleic Anhydride Copolymer	ca 100	unlisted

Section 3 - Hazards Identification

EMERGENCY OVERVIEW

Appearance: off-white powder.
Caution! May cause eye and skin irritation. May cause respiratory and digestive tract irritation. The toxicological properties of this material have not been fully investigated.
Target Organs: None known.

Potential Health Effects
Eye: May cause eye irritation. The toxicological properties of this material have not been fully investigated.
Skin: May cause skin irritation. The toxicological properties of this material have not been fully investigated.
Ingestion: May cause gastrointestinal irritation with nausea, vomiting and diarrhea.
Inhalation: May cause respiratory tract irritation. The toxicological properties of this substance have not been fully investigated.
Chronic: No information found.

Section 4 - First Aid Measures

Eyes: Flush eyes with plenty of water for at least 15 minutes, occasionally lifting the upper and lower eyelids. Get medical aid.
Skin: Get medical aid. Flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Wash clothing before reuse.
Ingestion: Never give anything by mouth to an unconscious person. Get medical aid. Do NOT induce vomiting. If conscious and alert, rinse mouth and drink 2-4 cupfuls of milk or water.
Inhalation: Remove from exposure and move to fresh air immediately. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical aid.
Notes to Physician: Treat symptomatically and supportively.

Section 5 - Fire Fighting Measures

General Information: As in any fire, wear a self-contained breathing apparatus in pressure-demand, MSHA/NIOSH (approved or equivalent), and full protective gear. During a fire, irritating and highly toxic gases may be generated by thermal decomposition or combustion.
Extinguishing Media: Use agent most appropriate to extinguish fire. Use water spray, dry chemical, carbon dioxide, or appropriate foam.
Flash Point: Not available.
Autoignition Temperature: Not available.
Explosion Limits, Lower: Not available.
Upper: Not available.
NFPA Rating: (estimated) Health: 1; Flammability: 0; Instability: 0

Section 6 - Accidental Release Measures

General Information: Use proper personal protective equipment as indicated in Section 8.
Spills/Leaks: Clean up spills immediately, observing precautions in the Protective Equipment section. Sweep up, then place into a suitable container for disposal. Avoid generating dusty conditions. Provide ventilation.

Section 7 - Handling and Storage

Handling: Wash thoroughly after handling. Remove contaminated clothing and wash before reuse. Use with adequate ventilation. Minimize dust generation and accumulation. Avoid contact with eyes, skin, and clothing. Keep container tightly closed. Avoid ingestion and inhalation.
Storage: Store in a tightly closed container. Store in a cool, dry, well-ventilated area away from incompatible substances.

Section 8 - Exposure Controls, Personal Protection

Engineering Controls: Use adequate ventilation to keep airborne concentrations low.
Exposure Limits

Chemical Name	ACGIH	NIOSH	OSHA - Final PELs
Styrene/maleic Anhydride Copolymer	none listed	none listed	none listed

OSHA Vacated PELs: Styrene/maleic Anhydride Copolymer: No OSHA Vacated PELs are listed for this chemical.
Personal Protective Equipment
Eyes: Wear appropriate protective eyeglasses or chemical safety goggles as described by OSHA's eye and face protection regulations in 29 CFR 1910.133 or European Standard EN166.
Skin: Wear appropriate protective gloves to prevent skin exposure.
Clothing: Wear appropriate protective clothing to prevent skin exposure.
Respirators: Follow the OSHA respirator regulations found in 29 CFR 1910.134 or European Standard EN 149. Use a NIOSH/MSHA or European Standard EN 149 approved respirator if exposure limits are exceeded or if irritation or other symptoms are experienced.

Section 9 - Physical and Chemical Properties

Physical State: Powder
Appearance: off-white
Odor: None reported.
pH: Not available.
Vapor Pressure: Not available.
Vapor Density: Not available.
Evaporation Rate: Not available.
Viscosity: Not available.
Boiling Point: Not available.
Freezing/Melting Point: Not available.
Decomposition Temperature: Not available.
Solubility: Not available.
Specific Gravity/Density:1.2700g/cm3
Molecular Formula: Polymer
Molecular Weight: Not available.

Section 10 - Stability and Reactivity

Chemical Stability: Stable under normal temperatures and pressures.
Conditions to Avoid: Incompatible materials, dust generation, excess heat, strong oxidants.
Incompatibilities with Other Materials: Oxidizing agents.
Hazardous Decomposition Products: Carbon monoxide, irritating and toxic fumes and gases, carbon dioxide.
Hazardous Polymerization: Has not been reported.

Section 11 - Toxicological Information

RTECS#:
CAS# 9011-13-6: ON4240000
LD50/LC50:
CAS# 9011-13-6:
Draize test, rabbit, eye: 100 mg Mild;
Oral, rat: LD50 = 21 gm/kg;

Carcinogenicity:
CAS# 9011-13-6: Not listed by ACGIH, IARC, NTP, or CA Prop 65.

Epidemiology: No information available.
Teratogenicity: No information available.
Reproductive Effects: No information available.
Mutagenicity: No information available.
Neurotoxicity: No information available.
Other Studies:

Section 12 - Ecological Information

No information available.

Section 13 - Disposal Considerations

Chemical waste generators must determine whether a discarded chemical is classified as a hazardous waste. US EPA guidelines for the classification determination are listed in 40 CFR Parts 261.3. Additionally, waste generators must consult state and local hazardous waste regulations to ensure complete and accurate classification.
RCRA P-Series: None listed.
RCRA U-Series: None listed.

Section 14 - Transport Information

	US DOT	Canada TDG
Shipping Name:	Not regulated as a hazardous material	No information available.
Hazard Class:		
UN Number:		
Packing Group:		

Section 15 - Regulatory Information

US FEDERAL

TSCA
CAS# 9011-13-6 is listed on the TSCA inventory.
Health & Safety Reporting List
None of the chemicals are on the Health & Safety Reporting List.
Chemical Test Rules
None of the chemicals in this product are under a Chemical Test Rule.
Section 12b
None of the chemicals are listed under TSCA Section 12b.
TSCA Significant New Use Rule
None of the chemicals in this material have a SNUR under TSCA.
CERCLA Hazardous Substances and corresponding RQs
None of the chemicals in this material have an RQ.
SARA Section 302 Extremely Hazardous Substances
None of the chemicals in this product have a TPQ.
Section 313 No chemicals are reportable under Section 313.
Clean Air Act:
This material does not contain any hazardous air pollutants.
This material does not contain any Class 1 Ozone depletors.
This material does not contain any Class 2 Ozone depletors.
Clean Water Act:
None of the chemicals in this product are listed as Hazardous Substances under the CWA.
None of the chemicals in this product are listed as Priority Pollutants under the CWA.
None of the chemicals in this product are listed as Toxic Pollutants under the CWA.
OSHA:
None of the chemicals in this product are considered highly hazardous by OSHA.
STATE
CAS# 9011-13-6 is not present on state lists from CA, PA, MN, MA, FL, or NJ.

California Prop 65

California No Significant Risk Level: None of the chemicals in this product are listed.

European/International Regulations
European Labeling in Accordance with EC Directives
Hazard Symbols:
Not available.
Risk Phrases:

Safety Phrases:
S 24/25 Avoid contact with skin and eyes.
S 37 Wear suitable gloves.
S 45 In case of accident or if you feel unwell, seek medical advice immediately (show the label where possible).
S 28A After contact with skin, wash immediately with plenty of water
,

WGK (Water Danger/Protection)
CAS# 9011-13-6: No information available.
Canada - DSL/NDSL
CAS# 9011-13-6 is listed on Canada's DSL List.
Canada - WHMIS
WHMIS: Not available.
This product has been classified in accordance with the hazard criteria of the Controlled Products Regulations and the MSDS contains all of the information required by those regulations.
Canadian Ingredient Disclosure List

Section 16 - Additional Information

9.12. Security data sheet Tween 20

ThermoFisher SCIENTIFIC

SAFETY DATA SHEET

Creation Date 22-Dec-2010 Revision Date 18-Jan-2018 Revision Number 5

1. Identification

Product Name	Tween® 20
Cat No. :	BP337-100; BP337-500; XXBP3374LI; NC1630717
CAS-No	9005-64-5
Synonyms	Polyoxyethylene(20)sorbitan monolaurate
Recommended Use	Laboratory chemicals.
Uses advised against	Food, drug, pesticide or biocidal product use

Details of the supplier of the safety data sheet

Company
Fisher Scientific
One Reagent Lane
Fair Lawn, NJ 07410
Tel: (201) 796-7100

Emergency Telephone Number
CHEMTREC®, Inside the USA: 800-424-9300
CHEMTREC®, Outside the USA: 001-703-527-3887

2. Hazard(s) identification

Classification
Classification under 2012 OSHA Hazard Communication Standard (29 CFR 1910.1200)

Not a dangerous substance or mixture according to the Globally Harmonized System (GHS)

Label Elements

Hazard Statements

Precautionary Statements
Hazards not otherwise classified (HNOC)
None identified

3. Composition/Information on Ingredients

Component	CAS-No	Weight %

Polyoxyethylene(20)sorbitan monolaurate	9005-64-5	>95

4. First-aid measures

Eye Contact	Rinse immediately with plenty of water, also under the eyelids, for at least 15 minutes. Get medical attention.
Skin Contact	Wash off immediately with plenty of water for at least 15 minutes. Get medical attention immediately if symptoms occur.
Inhalation	Move to fresh air. Get medical attention immediately if symptoms occur. If not breathing, give artificial respiration.
Ingestion	Do not induce vomiting. Obtain medical attention.
Most important symptoms and effects	No information available.
Notes to Physician	Treat symptomatically

5. Fire-fighting measures

Suitable Extinguishing Media	Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide.
Unsuitable Extinguishing Media	No information available
Flash Point	> 150 °C / > 302 °F
Method -	No information available
Autoignition Temperature	No information available
Explosion Limits	
Upper	No data available
Lower	No data available
Sensitivity to Mechanical Impact	No information available
Sensitivity to Static Discharge	No information available

Specific Hazards Arising from the Chemical
Thermal decomposition can lead to release of irritating gases and vapors.

Hazardous Combustion Products
Carbon monoxide (CO) Carbon dioxide (CO_2)
Protective Equipment and Precautions for Firefighters
As in any fire, wear self-contained breathing apparatus pressure-demand, MSHA/NIOSH (approved or equivalent) and full protective gear.

NFPA

Health	Flammability	Instability	Physical hazards
0	1	0	N/A

6. Accidental release measures

Personal Precautions	Use personal protective equipment. Ensure adequate ventilation. Avoid contact with skin, eyes and clothing.
Environmental Precautions	Should not be released into the environment. See Section 12 for additional ecological information.

Methods for Containment and Clean Up: Soak up with inert absorbent material. Keep in suitable, closed containers for disposal.

7. Handling and storage

Handling	Wear personal protective equipment. Ensure adequate ventilation. Do not breathe vapors or spray mist. Avoid contact with skin and eyes. Do not ingest.
Storage	Keep containers tightly closed in a dry, cool and well-ventilated place. Store indoors.

8. Exposure controls / personal protection

Exposure Guidelines	This product does not contain any hazardous materials with occupational exposure limitsestablished by the region specific regulatory bodies.
Engineering Measures	None under normal use conditions.
Personal Protective Equipment	
Eye/face Protection	Wear appropriate protective eyeglasses or chemical safety goggles as described by OSHA's eye and face protection regulations in 29 CFR 1910.133 or European Standard EN166.
Skin and body protection	Wear appropriate protective gloves and clothing to prevent skin exposure.
Respiratory Protection	No protective equipment is needed under normal use conditions.
Hygiene Measures	Handle in accordance with good industrial hygiene and safety practice.

9. Physical and chemical properties

Physical State	Very viscous Liquid
Appearance	Amber
Odor	No information available
Odor Threshold	No information available
pH	6 10% aq. solution
Melting Point/Range	No data available
Boiling Point/Range	> 100 °C / 212 °F
Flash Point	> 150 °C / > 302 °F
Evaporation Rate	No information available
Flammability (solid,gas)	Not applicable
Flammability or explosive limits	
Upper	No data available
Lower	No data available
Vapor Pressure	No information available
Vapor Density	No information available
Specific Gravity	1.100
Solubility	Soluble in water
Partition coefficient; n-octanol/water	No data available
Autoignition Temperature	No information available
Decomposition Temperature	No information available
Viscosity	400 mPa.s at 25 °C

10. Stability and reactivity

Reactive Hazard	None known, based on information available
Stability	Stable under normal conditions.
Conditions to Avoid	Incompatible products. Excess heat.
Incompatible Materials	Strong oxidizing agents

Hazardous Decomposition Products Carbon monoxide (CO), Carbon dioxide (CO_2)

Hazardous Polymerization Hazardous polymerization does not occur.

Hazardous Reactions None under normal processing.

11. Toxicological information

Acute Toxicity

Product Information
Component Information

Component	LD50 Oral	LD50 Dermal	LC50 Inhalation
Polyoxyethylene(20)sorbitan monolaurate	LD50 = 37000 mg/kg (Rat) LD50 = 36700 µL/kg (Rat)	Not listed	Not listed

Toxicologically Synergistic Products No information available

Delayed and immediate effects as well as chronic effects from short and long-term exposure

Irritation No information available

Sensitization No information available

Carcinogenicity The table below indicates whether each agency has listed any ingredient as a carcinogen.

Component	CAS-No	IARC	NTP	ACGIH	OSHA	Mexico
Polyoxyethylene(20)sorbitan monolaurate	9005-64-5	Not listed	Not listed	Not listed	Not listed	Not listed

Mutagenic Effects No information available

Reproductive Effects No information available.

Developmental Effects No information available.

Teratogenicity No information available.

STOT - single exposure None known
STOT - repeated exposure None known

Aspiration hazard No information available

Symptoms / effects,both acute and delayed No information available

Endocrine Disruptor Information No information available

Other Adverse Effects The toxicological properties have not been fully investigated.

12. Ecological information

Ecotoxicity
Do not empty into drains. .

Persistence and Degradability Soluble in water Persistence is unlikely based on information available.

Bioaccumulation/ Accumulation No information available.

Mobility Will likely be mobile in the environment due to its water solubility.

13. Disposal considerations

Waste Disposal Methods: Chemical waste generators must determine whether a discarded chemical is classified as a hazardous waste. Chemical waste generators must also consult local, regional, and national hazardous waste regulations to ensure complete and accurate classification.

14. Transport information

DOT	Not regulated
TDG	Not regulated
IATA	Not regulated
IMDG/IMO	Not regulated

15. Regulatory information

United States of America Inventory

Component	CAS-No	TSCA	TSCA Inventory notification - Active/Inactive	TSCA - EPA Regulatory Flags
Polyoxyethylene(20)sorbitan monolaurate	9005-64-5	X	ACTIVE	XU

Legend:
TSCA - Toxic Substances Control Act, (40 CFR Part 710)
X - Listed
'-' - Not Listed
XU - Indicates a substance exempt from reporting under the Inventory Update Rule, i.e. Partial Updating of the TSCA Inventory Data Base Production and Site Reports (40 CFR 710(B)

TSCA 12(b) - Notices of Export: Not applicable

International Inventories
Canada (DSL/NDSL), Europe (EINECS/ELINCS/NLP), Philippines (PICCS), Japan (ENCS), Australia (AICS), China (IECSC), Korea (ECL).

Component	CAS-No	DSL	NDSL	EINECS	PICCS	ENCS	AICS	IECSC	KECL
Polyoxyethylene(20)sorbitan monolaurate	9005-64-5	X	-	-	X	X	X	X	KE-31681

U.S. Federal Regulations

SARA 313	Not applicable
SARA 311/312 Hazard Categories	See section 2 for more information
CWA (Clean Water Act)	Not applicable
Clean Air Act	Not applicable
OSHA - Occupational Safety and Health Administration	Not applicable
CERCLA	Not applicable
California Proposition 65	This product does not contain any Proposition 65 chemicals
U.S. State Right-to-Know Regulations	Not applicable
U.S. Department of Transportation Reportable Quantity (RQ):	N
DOT Marine Pollutant	N
DOT Severe Marine Pollutant	N

U.S. Department of Homeland Security	This product does not contain any DHS chemicals.

Other International Regulations

Mexico - Grade	No information available

16. Other information

Prepared By	Regulatory Affairs Thermo Fisher Scientific Email: EMSDS.RA@thermofisher.com
Creation Date	22-Dec-2010
Revision Date	18-Jan-2018
Print Date	18-Jan-2018
Revision Summary	This document has been updated to comply with the US OSHA HazCom 2012 Standard replacing the current legislation under 29 CFR 1910.1200 to align with the Globally Harmonized System of Classification and Labeling of Chemicals (GHS).

Disclaimer
The information provided in this Safety Data Sheet is correct to the best of our knowledge, information and belief at the date of its publication. The information given is designed only as a guidance for safe handling, use, processing, storage, transportation, disposal and release and is not to be considered a warranty or quality specification. The information relates only to the specific material designated and may not be valid for such material used in combination with any other materials or in any process, unless specified in the text

End of SDS

9.13. Security data sheet Zinc Stearete

Safety Data Sheet (SDS)
Revision / Review Date: 11/14/14

1. Chemical Product and Company Identification

Product Name:	Zinc Stearate G
Distributed By:	HB Chemical 1665 Enterprise Parkway Twinsburg Oh 44087 Phone - 330-920-8023
MSDS Prepared By (w Suppliers Input):	HB Chemical
Chemical Name / Family:	Zinc distearate Stearic Acid, Zinc salt
CAS No.:	557-05-1
OSHA Status	Not Hazardous

For emergency health, safety, and environmental information, calls 330-920-8023
For emergency transportation information, in the United States: call CHEMTREC at 800-424-9300

2. Hazard(s) Identification

Physical Hazards:	Not classified.
Health hazards:	Not classified.
Environmental hazards:	Not classified.
OSHA defined hazards:	Not classified.
Label elements:	
Hazard symbol:	None.
Signal word:	None.
Hazard statement:	The substance does not meet the criteria for classification.
Precautionary Statement:	
Prevention:	Observe good industrial hygiene practices.
Response:	Wash hands after handling.
Storage:	Store away from incompatible materials.
Disposal:	Dispose of waste and residues in accordance with local authority requirements.
Hazard not otherwise classified (HNOC):	None known.
Supplemental information:	None

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3. Composition / Information on Ingredients

Substances

Chemical name	Common name and synonyms	CAS number	%
Zinc Stearate	Zinc distearate, Zinc salt of stearic acid	557-05-1	100

*Designates that a specific chemical identity and/or percentage of composition has been withheld as a trade secret.

4. First Aid Measures

Most important symptoms/effects, acute and delayed:	Coughing. Irritation of eyes and mucous membranes. Upper respiratory tract irritation. Skin irritation
Indication of immediate medical attention and special treatment needed:	Treat Symptomatically.
General information:	Ensure that medical personnel are aware of the material involved and take precautions to protect themselves.
Inhalation:	if dust from the material is inhaled, remove the affected person immediately to fresh air. Call a physician if symptoms develop or persist.
Eyes:	Rinse with water. Get medical attention if irritation develops and persists.
Skin:	Wash off with soap and water. Get medical attention if irritation develops and persists.
Ingestion:	Rinse mouth. Get medical attention if symptoms occur.

5. Fire-Fighting Measures

Suitable Extinguishing Media:	Water fog. Dry chemical powder. Carbon dioxide (CO2).
Unsuitable extinguishing media:	Do not use water jet as extinguisher, as this will spread the fire.
Special hazards arising from the chemical:	During fire, gases hazardous to health may be formed.
Special protective equipment and Precautions for firefighters:	Self-contained breathing apparatus and full protective clothing must be worn in case of fire.
Fire-Fighting equipment /instructions:	Move containers from fire area if you can do so without risk.
Specific methods:	Use standard firefighting procedures and consider the hazards of other involved materials.
General fire hazards:	No unusual fire or explosion hazards noted.

6. Accidental Release Measures

Personal precautions, protective equipment and emergency procedures:	Keep unnecessary personnel away. Keep people away from and upwind of spill/leak. Keep out of low areas. Avoid inhalation of dust from the spilled material. Use a NOIOSH/MSHA approved respirator if there is a risk of exposure to dust/fume at levels exceeding exposure limits. Do touch damaged containers or spilled material unless wearing appropriate protective clothing. For personal protection see section 8 of the SDS.
Methods and materials for containment and cleaning up:	the product is immiscible with water and will sediment in water systems. If sweeping of a contaminated area is necessary use a dust suppressant agent which does not react with the product. Collect dust using a vacuum cleaner equipped with HEPA filter. Minimize dust generation and accumulation. Prevent entry into waterways, sewer, basements or confined areas. Following product recovery, flush area with water. For waste disposal, see section 13 of the SDS.
Environmental precautions:	Avoid discharge into drains, water courses or onto the ground.

7. Handling and Storage:

Precautions for safe handling:	Provide appropriate exhaust ventilation at places where dust Is formed.
Conditions for safe storage:	Store in original container. Store in a well-ventilated place. Store away from incompatible materials. (See Section 10 of the SDS.) Store in a cool, dry, ventilated area. Keep containers

8. Exposure Controls / Personal Protection

Occupational exposure limits

US. OSHA Table Z-1 Limits for Air Contaminants (29 CFR 1910.1000)

Material	Type	Value	Form
Zinc Stearate (CAS 557-05-1)	PEL	5 mg/m3	Respirable fraction
		15 mg/m3	Total dust

US. ACGIH Threshold Limit Values

Material	Type	Value
Zinc Stearate (CAS 557-05-1)	TWA	10 mg/m3

US. NIOSH: Pocket Guide to Chemical Hazards

Material	Type	Value	Form
Zinc Stearate (CAS 557-05-1)	TWA	5 mg/m3	Respirable
		10 mg/m3	Total

Biological limit values:	No biological exposure limits noted for the ingredients.
Appropriate engineering controls:	Good general ventilation (typically 10 air changes per hour) should be used. Ventilation rates should be matched to conditions. If applicable use process enclosures, local exhaust ventilation, or other engineering controls to maintain airborne levels below recommended exposure limits. If exposure limits have not been established, maintain airborne levels to an acceptable level. Ventilation should be sufficient to effectively remove and prevent buildup of any dusts or fumes that may be generated during handling or thermal processing. If engineering measures are not sufficient to maintain concentration of dust particulates below the Occupational Exposure limit (OEL), suitable respiratory protection must be worn.
Respiratory Protection:	Use NIOSH/MSHA approved respirator if there is a risk of exposure to dust/fume at levels exceeding the exposure limits.
Thermal hazards:	Wear appropriate thermal protective clothing, when necessary.
Protective Gloves:	Wear appropriate chemical resistant gloves.
Eye Protection:	Use tight fitting goggles if dust is generated.
Skin and Body Protection:	Wear suitable protective clothing.
General hygiene considerations:	Always observe good personal hygiene measures, such as washing after handling the material and before eating, drinking, and/or smoking. Routinely wash work clothing and protective equipment to remove contaminants..

9. Physical and Chemical Properties

Appearance	
Physical state	Solid.
Form	Powder, Flakes, Granular.
Color	White.
Odor	Slight
Odor threshold	Not available.
pH	7 – 9 @ 20 °C (in solution)
Melting point/freezing point	266 °F (130 °C)
Initial boiling point and boiling range	Not available.
Flash point	> 212.0 °F (>100.0 °C) Cleveland Open Cup
Evaporation rate	Not available.
Flammability (solid, gas)	Not available.
Upper/lower flammability or explosive limits	
Flammability limit – lower (%)	Not available.
Flammability limit – upper (%)	Not available.

Explosive limit – lower (%)	Not available.
Explosive limit – upper (%)	Not available.
Vapor pressure	< 0.0000001 kPa @ 25 °C.
Vapor density	Not available.
Relative density	1.095 g/cm3
Solubility(ies)	
Solubility (water)	Insoluble
Partition coefficient (n-octanol/water)	Not available.
Auto-ignition temperature	788 °F (420 °C)
Decomposition temperature	Not available.
Viscosity	Not available.
Other information	
Density	1.10 g/cm3 estimated

Flammability	Combustible IIIB estimated
Flash point class	Combustible IIIB
Molecular formula	C18-H36-O2.1/2Zn
Molecular weight	632.34 g/mol
Specific gravity	1.1

10. Stability and Reactivity

Reactivity:	The product is stable and non-reactive under normal conditions. of use, storage and transport.
Stability:	This product is stable under normal conditions.
Incompatibility (Materials to Avoid):	Strong oxidizing agents.
Conditions to Avoid:	Avoid temperatures exceeding the flash point. Contact with incompatible materials. Avoid dispersal of dust in the air (i.e., clearing dust surfaces with compressed air).
Hazardous decomposition products:	No hazardous decomposition products are known.

11. Toxicological Information

Information on likely routes of exposure

Ingestion:	Expected to be a low ingestion hazard.
Inhalation:	Prolonged inhalation may be harmful. Inhalation of dusts may cause respiratory irritation.
Skin contact:	No adverse effects due to skin contact are expected.
Eye contact:	Dust in the eyes will cause irritation.

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Symptoms related to the physical physical, chemical and toxicological characteristics:	Coughing. Upper respiratory tract irritation. Irritation of eyes and mucous membranes. Skin irritation.
Information on toxicological effects	
Acute toxicity:	Not available.
Skin corrosion/irritation:	Prolonged skin contact may cause temporary irritation.
Serious eye damage/eye irritation:	Dust in the eyes will cause irritation.
Respiratory or skin sensitization:	
Respiratory sensitization:	Not available.
Skin sensitization:	This product is not expected to cause skin sensitization.
Germ cell mutagenicity:	No data available to indicate product or any components present at greater than 0.1% are mutagenic or genotoxic.
Carcinogenicity:	This product is not considered to be a carcinogen by IARC, ACGIH, NTP, or OSHA.
OSHA Specifically Regulated Substances (29 CFR 1910.1001-1050):	Not listed.
Reproductive toxicity:	This product is not expected to cause reproductive or developmental effects.
Specific target organ toxicity- single exposure:	Not classified.
Specific target organ toxicity-repeated exposure:	Not classified.
Aspiration hazard:	Not available.
Chronic effects:	Prolonged inhalation may be harmful.

12. Ecological Information

Ecotoxicity:	The product is not classified as environmentally hazardous. However, this does not exclude the possibility that large or frequent spills can have a harmful or damaging effect on the environment.
Persistence and degradability:	No data is available on the degradability of this product.
Bioaccumulative potential:	No data available.
Mobility in soil:	No data available.
Other adverse effects:	No other adverse environmental effects (e.g. ozone depletion, photochemical ozone creation potential, endocrine disruption, global warming potential) are expected from this component

13. Disposal Considerations

Disposal instructions:	Collect and reclaim or dispose in sealed containers at licensed waste disposal site.
Local disposal regulations:	Dispose in accordance with all applicable regulations.
Hazardous waste code:	The waste code should be assigned in discussion between the user, the producer and the waste disposal company.
Waste from residues /unused products:	Dispose of in accordance with local regulations. Empty containers or liners may retain some product residues. This material and its container must be disposed of in a safe manner (see: Disposal instructions).
Contaminated packaging:	Empty containers should be taken to an approved waste handling site for recycling or disposal.

14. Transport Information

D.O.T. Shipping Name	Not regulated as dangerous goods.
Air - ICAO (international Civil Aviation Organization)	Not regulated as dangerous goods.
Sea - IMDG (International Maritime Dangerous Goods)	Not regulated as dangerous goods.

15. Regulatory Information

US federal regulations All components are on the U.S. EPA TSCA Inventory List.
This product is a "Hazardous Chemical" as defined by the OSHA Hazard Communication Standard, 29 CFR 1910.1200.

CERCLA Hazardous Substance List (40 CFR 302.4)
Zinc Stearate (CAS 557-05-1) Listed.

SARA 304 Emergency release notification
Not regulated.

OSHA Specifically Regulated Substances (29 CFR 1910.1001-1050)
Not listed.

Superfund Amendments and Reauthorization Act of 1986 (SARA)

Hazard categories
Immediate Hazard - No
Delayed Hazard - No
Fire Hazard - Yes
Pressure Hazard - No
Reactivity Hazard - No

SARA 302 Extremely hazardous substance
Not listed.

SARA 311/312 Yes
Hazardous chemical
SARA 313 (TRI reporting)

Chemical name	CAS number	% by wt.
Zinc coumpounds	557-05-1	100

Other federal regulations

Clean Air Act (CAA) Section 112 Hazardous Air Pollutants (HAPs) List

Not regulated.

Clean Air Act (CAA) Section 112(r) Accidental Release Prevention (40 CFR 68.130)

Not regulated.

Safe Drinking Water Act (SDWA)

Not regulated.

US state regulations

US. Massachusetts RTK - Substance List

Zinc Stearate (CAS 557-05-1)

US. New Jersey Worker and Community Right-to-Know Act

Zinc Stearate (CAS 557-05-1)

US. Pennsylvania Worker and Community Right-to-Know Law

Zinc Stearate (CAS 557-05-1)

US. Rhode Island RTK

Zinc Stearate (CAS 557-05-1)

US. California Proposition 65

California Safe Drinking Water and Toxic Enforcement Act of 1986 (Proposition 65): This material is not known to contain any chemicals currently listed as carcinogens or reproductive toxins.

International Inventories

Country(s) or region	Inventory name	On inventory (yes/no)*
Australia	Australian Inventory of Chemical Substances (AICS)	Yes
Canada	Domestic Substances List (DSL)	Yes
Canada	Non-Domestic Substances List (NDSL)	No
China	Inventory of Existing Chemical Substances in China (IECSC)	Yes
Europe	European Inventory of Existing Commercial Chemical Substances (EINECS)	Yes
Europe	European List of Notified Chemical Substances (ELINCS)	No
Japan	Inventory of Existing and New Chemical Substances (ENCS)	Yes
Korea	Existing Chemicals List (ECL)	Yes
New Zealand	New Zealand Inventory	Yes
Philippines	Philippine Inventory of Chemicals and Chemical Substances (PICCS)	Yes
United States & Puerto Rico	Toxic Substances Control Act (TSCA) Inventory	Yes

*A "Yes" indicates that all components of this product comply with the inventory requirements administered by the governing country(s)
A "No" indicates that one or more components of the product are not listed or exempt from listing on the inventory administered by the governing country(s).

16. Other Information

HMIS® ratings	Health: 0 Flammability: 0 Physical hazard: 0
NFPA ratings	Health: 0 Flammability: 2 Instability: 0

The above information has been compiled from what we believe to be credible sources. To our knowledge the information is accurate and reliable, however, it is not guaranteed. Any recommendations issued by HB Chemical personnel or literature is derived from experience and by no means should be taken as fact or construed as a recommendation to violate of any law, regulation or patent. It is the users responsibility to determine the suitability of any HB supplied material in their application. The individual conditions of each customer are well outside of our control and we cannot be held liable for its functionality and use. Please contact our office should you need specific information beyond what is supplied above. As with all Chemical usage safety precautions beyond the stated are highly recommended.

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Phone 330-920-8023 Fax 330-920-0971
www.hbchemical.com

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